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AND THE RECORDING OF

AMERICAN AND OTHER PATENTED INVENTIONS.

EDITED

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Practical and Theoretical Mechanics and Chemistry.

Brief Observations on Common Mortars, Hydraulic Mortars, and Concretes; with some Experiments made therewith, at Fort Adams, Newport Harbour, R. I., from 1825 *to* 1838; *by J. G. Totten, Lt. Col. of Eng. and Brevet Col. United States Army.*

SECTION V.

ARTICLE XXIII.—*On Lime, Hydraulic Cement, Sand, Mortar making, Strength of Mortars and Grout.*

(CONTINUED FROM VOL. XXI., PAGE 383.)

During the progress of operations under my direction in the construction of Fort Adams, in Newport Harbour, Rhode Island, many experiments were made with mortars exposed in the air; giving, in some cases, results quite interesting. The results are too limited in number and restricted in variety, to justify the deduction of general principles; still they afford some hints that may be deemed worthy of being followed up.

The following tables contain these results in a very condensed form; but before giving the tables, it is proper to make some observations on the materials employed—the manner of using them, and the modes adopted of trying the relative strengths of the essays.

Lime.—Three kinds of lime were used, namely:

1st. "*Smithfield Lime.*"—From Smithfield, R. I. about fifteen miles from Providence. This is a very fat lime—slaking with great violence, when properly burned, and affording a large bulk of slaked lime.

2d. "*Thomastown Lime.*"—From Thomastown (Maine.) This is also a fat lime, at least so far as it has been tried at Fort Adams: but it is probable that some of the many varieties—including those of the neighbouring towns of Lincolnville, and Camden, may prove to be hydraulic. The richer varieties slake promptly, giving a large bulk of slaked lime.

3d. *Fort Adams Lime.* This is made from a ledge of whitish transition limestone found within the domain of the Fort. The stone is very fine grained and compact, exceedingly difficult to break, and crossed in all directions by three veins of whitish quartz. The ledge is a bed, or large nodule, in graywacke-slate. After calcination it yields, by sluggish slaking, a lime decidedly hydraulic. A little of this lime, after being slaked, was made into a cake of stiff hydrate; the excess of water being absorbed by bibulous paper: the cake was placed in the bottom of a tumbler and covered immediately with water. In about $7\frac{1}{2}$ days, a wire $\frac{1}{24}$ of an inch in diameter, loaded to weigh 1 lb., made no impression on this hydrate.

Three modes of slaking the lime were tried in these experiments, namely:

1st. *Slaking by Sprinkling.*—In this mode, water, in quantity sufficient to slake the lime to dry powder, but not enough to afford moist powder, was sprinkled upon the lime. The lime was not made into mortar until it had become cold.

2nd. *Slaking by Drowning.*—In this mode, water enough was given, in the first place, to reduce the lime to a cream of such consistency as to afford mortar of proper "*temper*" for common use without any further addition of water, provided the mortar was made up immediately. If the making the mortar was delayed, a further supply of water became necessary.

3d. *Air-slaking.*—In this mode, lime, reduced to pieces about the size of a walnut, was left in the air to slake spontaneously.

These were the processes by which the lime used in the experiments was slaked: but by neither of these, nor by any modification recommended by others, or that we, ourselves, could devise, were we able to free the hydrate from an infinity of small particles of lime, that being imperfectly, or not at all, slaked in the first instance, it was almost impossible, by any amount of labour afterward, to break down and mix with the rest. The mortar mill, hereafter described, reduced these refractory particles better than any of the ordinary modes of acting upon lime; but not sufficiently, without an unwarrantable amount of labour. All other means having failed, resort was had, at last, for the mortar for the masonry of the Fort, to grinding the dry lime to a very fine powder between millstones. Lime thus ground gives a perfectly homogeneous mortar: and some partial experiments lead to the opinion that the gain in the quantity of lime available for mixtures with sand, will, nearly if not quite, compensate for the expense of grinding. So far as the mortar thus made has been tried, the results were favourable: but the experiments on the quantity and quality of lime thus treated, though they justify confidence, are not, yet, so conclusive as to warrant any positive assertions.

Hydraulic Cement.—Three kinds of hydraulic cement were employed—namely, a kind that will be here designated as *hydraulic cement A*, which was supplied from the State of New York—another kind, called *hydraulic cement B*, supplied from a different manufactory in the same State—and "*Roman (or Parker's) cement*," imported from England.

The experiments will show a material difference in the respective qualities of these hydraulic cements. According to them, cement A was the best, cement B the next best, and the "Roman cement" the worst; but it must be remarked that the last mentioned had, no doubt, greatly deteriorated, from imbibing moisture during a long voyage, and long keeping in store; while there is reason to suppose that the two first mentioned had been calcined within a few weeks. Between these two, there was also a marked difference; but though the superiority of cement A was probably in part

intrinsic, it was, no doubt, in part, to be ascribed to its greater freshness. These cements, therefore, should, in our tables, be compared with themselves under various combinations with other ingredients, rather than with each other.

This is perhaps the best place to mention a very certain and satisfactory mode of testing the hydraulic quality of lime or cement. It is derived from Raucourt's work on mortars.

Of the lime or cement to be tried, a cake of quite stiff hydrate must be made of a size to lie, without touching the sides, in the bottom of a tumbler: any excess of water should be absorbed from the cake by bibulous paper, until it will just support a wire $\frac{1}{12}$ of an inch in diameter loaded to weigh $\frac{1}{4}$ of a pound—this wire should barely make its impression. Noting the hour and minute of the watch, the cake, thus prepared, should be placed in the tumbler, and covered immediately with water. If the specimen be very hydraulic, it will set almost instantly; if not very hydraulic, it may require days, and if but slightly hydraulic, it may require weeks to harden. In order to have some invariable measure of what we call *setting*, we have always used a wire $\frac{1}{24}$ of an inch in diameter, loaded to weigh 1 pound.

With these two simple instruments, and these simple appliances, the comparative hydraulic qualities of limes and cements may be detected infallibly. It may not be strictly accurate to say that those cements which indurate most promptly under water will afford the strongest mortars in the air; although that has, for the greater part, appeared to be the case, in our experiments; still it is highly probable that such cements will be found among the best; it is, at any rate, amongst such that we should look when in search of mortars of superior excellence; and it is undoubtedly true, that when hydraulic qualities exist in lime, although in feeble proportion, the lime is essentially benefited. A simple means of testing hydraulic quality is therefore of value.

Our experience has, however, taught us one important caution in the use of this test; which is, to leave the cement in the water for a day or two, although it may have set in a few minutes. A cement was under trial which, at the expiration of 7 minutes had set so as to bear the small wire with the weight of 1 pound—and at the expiration of 15 minutes, with the weight of 2 pounds. In about two hours, however, it was entirely soft again, having been broken down by the slaking of some free lime that happened to be present, and which had not had time to slake before the hydraulic ingredients had indurated. After about fifteen hours it was taken out of the water, restored to the condition of stiff mortar, and again immersed. It now hardened very slowly, and was six days acquiring the test hardness. Such cements require peculiar treatment. It is evident that there is great hydraulic energy wasted in the first instance of immersion; because the subsequent swelling of the lime, breaks down the indurated mass; and, removing the hydraulic particles beyond the sphere of mutual action, prevents any useful effect from the remaining hydraulic power. The slaking the lime should, therefore, be complete before the cement is immersed. The best mode of slaking this lime has not been ascertained. Perhaps it would be best to sprinkle a little water on cement of this kind, leaving it for a few hours in the state of moist powder—perhaps leaving it exposed to spontaneous slaking for the requisite time—and perhaps throwing on a small quantity of water, in order to slake the lime, and then exposing the cement to heat for a short time, so as to drive off the water absorbed by the hydraulic constituents. This last mode is suggested by the following facts.

Some hydraulic cement A, which had been in a cask more than one year, on first opening the cask, hardened under water in three hours. After two or three days, it required five hours to harden; and after ten days, about nine hours—the cask being kept covered by the head lying loosely upon it. A little of this cement that had been out of the cask for more than a week, on being heated (but not to a red heat) for a few minutes, set under water in three hours. Some of the same cement that had been in the office, enclosed in paper, for about three weeks, required six hours to harden in water, while a little of it, after being kept on a red hot iron plate for about fifteen minutes, hardened in water in 45 minutes.

This power of restoring the energy of deteriorated cements may have many important applications.

Sand.

Several kinds of sand were used in the experiments, namely:

Sand No. 1.—This is the kind habitually used at Fort Adams in stone masonry. It is entirely free from dirt, and the particles, though not very sharp, are angular. Separated mechanically, it was found to consist, in 100 parts, in bulk, of

particles from	$\frac{1}{6}$ to $\frac{1}{12}$	of an inch in diameter—		about	10.00
do.	$\frac{1}{12}$ to $\frac{1}{24}$	do.	do.	do.	5.00
do.	$\frac{1}{24}$ to $\frac{1}{48}$	do.	do.	do.	48.00
do.	$\frac{1}{48}$ to dust			do.	45.00
do.	dust mostly silicious—no dirt			do.	4.50
100 parts in bulk producing				do.	112.50

Sand No. 2.—Is the above sand freed from particles larger than $\frac{1}{12}$ of an inch.

Sand No. 3.—Is the above sand freed from particles larger than $\frac{1}{48}$ of an inch.

Sand No. 4.—Is sand No. 2, pounded very fine after being freed from dust by washing.

Mortar Making.

With a view to a thorough incorporation of the constituents, at a small expense, and in order, at the same time, to break down the refractory particles of lime before mentioned, a mortar mill was constructed at the commencement of the works at Fort Adams in 1825, which has been in operation ever since.

The mill consists of a very heavy wheel about eight feet in diameter (having a tire one foot broad) moving in a circular trough fifteen inches wide at the bottom—the diameter of the circle being about twenty-one feet. The lime is slaked under the wheel, and ground until, with suitable additions of water, it has become a homogeneous paste sufficiently dilute to make mortar of the ordinary consistency. The requisite quantity of sand is then gradually sprinkled in, as the wheel is in motion. The draught is easy to the horse until near the last; when, for a few minutes, as he is giving the last turns, after all the sand has been thrown in, it is rather heavy.

It was found convenient to use three barrels of lime to each batch of mortar.

The three mortar mills of Fort Adams were competent to supply in one

day 3077 cubic feet of mortar, at a total expense of \$0.087 per cubic foot, viz.

105 casks of lime, at \$1.52 per cask,	\$159.60
2094 bushels of sand, at \$0.04 per bushel,	83.76
Carting sand to mill, \$0.12 for 20 bushels,	12.56
3 horses and 3 drivers, at \$1.50 per day,	4.50
6 labourers, at \$1.00 per day,	6.00
1 cooper at \$1.00 per day,	1.00
Other small expenses say	0 58
Total cost of 3077 cubic feet of mortar	\$268.00

or \$0.087 per cubic foot. It appears that the expense of *making* the mortar was \$12.08, being about $\frac{1}{3}$ of a cent for a cubic foot.

The proportions in the above mortar are about 1 of lime in paste to $2\frac{1}{2}$ of sand—should the proportion of lime be greater, the mortar will, of course, cost more.

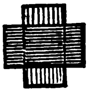
The above statement refers to mortar made without addition of any hydraulic substance. But such mortars are now never used at Fort Adams. Hydraulic cement, or burnt clay, or brick dust, or some other similar matter is added to every kind of mortar made at the work, in proportions varying with the purpose to which the mortar is to be applied. The poorest mortar we make contains 1 barrel of hydraulic cement to 3 barrels of unslaked lime and about 15 barrels of sand; the cement being added before the sand, and while the lime is being reduced under the wheel.

All the mortars used in the experiments in the tables, were made by hand with the trowel, with such exceptions, only, as are noticed.

Trials of the Strength of Mortars.

The strength of mortars as regards tenacity, was determined by measuring the force required to separate bricks that, having been joined by the mortar, had been left, for the desired length of time, in some place safe from frost or accident.

The bricks were joined in pairs, being crossed at right angles thus,



so that, supposing each brick to be 4 inches wide, the surface of contact would be 16 square inches. The real surface, or surface of effectual contact, was, in every case, found by actual measurement. The mortar joint separating the bricks was made about $\frac{3}{8}$ of an inch thick: and, in order that this mortar should in all cases be equally consolidated, each pair of bricks was submitted to the pressure of 600 lbs. for 5 minutes, immediately after being joined.

An idea of the mode of separating the bricks may be got from fig. 9, Pl. II, where *a* and *b* represent two strong half-staples fastened to the floor: under these the ends of the lower brick are passed, while the ends of the upper brick are embraced by the piece of iron *c, c*, suspended from the steelyard *d*. The force needed to separate the bricks, is applied by pouring sand, at a uniform rate, into the bucket *e*. The weight of the sand and bucket, the mark on the beam where the weight was applied, and the weight of the *poise*, enable us to ascertain the force necessary to tear the bricks asunder. In the tables, the force required to separate the bricks is reduced to the proportional force required to tear up a surface of one square inch: so that if there were 16 square inches of actual contact, and the force used in separating the bricks was 1000 pounds, the table would represent the tenacity of the mortar by $62\frac{1}{2}$ lbs.—equal to $\frac{1000}{16}$.

The hardness of the mortars was determined by ascertaining the weight, applied on a circular plane surface of 0.16 of an inch in diameter, (or .02008 of an inch area,) which the mortar would support. This mode of trial is represented in fig. 10, Pl. II. The circular surface at the extremity *a*, presses upon mortar still adhering to one of the bricks. The arms of the lever *b*, are of equal length, so that the upward force at *c* is equal to the pressure at *a*. The force is applied by means of a steelyard and sand, as in the preceding case.

The experiments were generally made with several pairs of bricks, and a mean was taken of the results; unless it had obviously been subjected to some accident or disturbance, being made to contribute to the mean. Very few results were rejected. There could be only as many trials of *tenacity*, in each particular experiment, as there were pairs of bricks. But for *hardness*, it was often possible to make a considerable number of distinct trials on the same surface of mortar: on the other hand, it would sometimes happen that the surface would be left too ragged and uneven for this trial: and in several instances this test seemed to be entirely inapplicable—the mortar beginning to yield with light weights, and continuing to yield more and more as the weight was increased, the whole effect being a gradual crumbling. In a great majority of cases, however, the effects were sufficiently decided to leave no doubt as to the moment when the power prevailed over the resistance—and sufficiently consistent to afford useful comparisons.

The method, just described, of trying the strength of mortars, was adopted in the Fort Adams experiments, on account of the facility of application. There was, in the first instance, no purpose of extending the experiments beyond what was deemed indispensable to a proper choice, and judicious application of materials, in the construction of a work of some magnitude, then being begun. One series of experiments, however, involved another and another, until the series became extended and the experiments too numerous and valuable, not to make it desirable that subsequent ones should be comparable with them, and, consequently, the same mode of test was continued.

It is probable that the method followed by Genl. Treussart, of making rectangular prisms of mortar, and subjecting them to fracture by weights suspended from the middle, is the best mode. It, at any rate, has the advantage of allowing mortars made in different places, and at distant times to be compared. This mode was adopted in some of the later trials at Fort Adams.

The following table exhibits the mean results of all the experiments made from 1825 to 1832; comprising seven series. The time of exposure of the 1st series was 5 months; of the 2nd. series, 10 months; of the 3rd, 10 months; of the 4th, 5 months; of the 5th, 10 months; of the 6th, 25 months; and of the 7th, 11 months. In the 1st series, there were 2 pairs of bricks to each experiment; in the 2nd, 3 pairs; in the 3rd, 3 pairs; in the 4th, 1 pair; in the 5th, 4 pairs; in the 6th, 2 pairs; and in 7th, 3 pairs.

The first column prefixes a number to each kind of mortar, for convenient reference; the 2nd column expresses the nature, or composition of the mortar; the 3rd column, whether the bricks were *wet* or *dry* when joined together; the 4th, the number of series of which the results are a mean as to *tenacity*; the 5th, the *tenacity*, as expressed by the number of pounds required to tear open a joint of one inch square; the 6th, the number of series of which the results are a mean as to *hardness;* and the 7th, the number of pounds required to force into the mortar a circular plane surface of 0.16 of an inch in diameter.

Table No. LXV.

No.	Nature and Composition of the mortar.	Bricks wet or dry.	Tenacity. Number of series affording the mean.	Tenacity. Mean tenacity.	Hardness. Number of series affording the mean.	Hardness. Mean hardness.	Remarks.
1	New York Hydraulic cement B, alone .	W	1	32.6			
2	do. do. do. A, alone . .	W	5	56.2	4	1053	
3	Roman cement (Parker's English) alone .	W	1	18.5	1	260	
4	do. (do.) alone	D	1	22.6	1	412	
5	Lime alone	W	1	10.5	1	98	
6	Hydraulic cement A in powder . 1; Sand No 3 .50	W	1	61.9	1	1055	
7	Cement A do. 1; Sand the same 1	W	6	40.3	5	993	
8	Cement A do. 1; Sand the same 1.50	W	5	33.1	4	918	
9	Cement A do. 1; Sand the same 1.50	D	2	30.4	1	765	
10	Hydraulic cement A in powder . 1; Sand No. 3 . 2	W	3	17.5	3	670	
11	Cement A do 1; Sand the same 3	W	3	19.8	2	367	
12	Cement A do. 1; Lime slaked to powder .50; Sand the same 1.50	W	2	29.6	3	573	
13	Cement A do. 1; Lime the same .50; Sand No. 2 2	W	4	20.1	3	509	
14	Cement A do. 1; Lime the same 1; Sand No. 2. 2	W	4	28.3	3	778	
15	Cement A do. 1; Lime the same 2; Sand No. 2 4	W	4	17.1	3	545	
16	Cement A do. 1; Lime the same 2; Sand No. 2 6	W	4	16.2	3	267	
17	Cement A do. 1; Lime in paste, .50; Sand No. 2 1.50	W	1	44.4	1	765	
18	Cement A 1; Lime in paste .50; Sand No. 2 1.50	D	1	54.7	1	915	
19	Cement B do. 1; Sand No. 3 1	W	2	18.9			
20	Cement B do. 1; Sand No. 2 1.50	W	1	23.4			
21	Cement B do. 1; Sand No. 2. 2	W	2	14.7			

Table No. LXV—Continued.

No.	Nature and Composition of the mortar.	Bricks wet or dry.	Tenacity. Number of series affording the mean.	Tenacity. Mean tenacity.	Hardness. Number of series affording the mean	Hardness. Mean hardness.	Remarks.
22	Cement B do. 1; Lime in powder slaked .50; Sand No. 2 2	W	2	17.5			
23	Cement B do. 1; Lime the same 1; Sand No. 2 2	W	2	19.1			
24	Hydraulic cement B in powder 1; Lime slaked in powder 2; Sand No. 2 4	W	2	18.1			
25	Cement B 1; Lime the same 2; Sand No. 2 6	W	2	15.0			
26	Roman cement 1; Sand No. 2 .50	W	1	19.2	1	397	
27	Roman cement 1; Sand No. 2 1	W	1	16.8	1	309	
28	Roman cement 1; Sand No. 2 1.50	W	1	13.3	1	286	
29	Roman cement 1; Lime in paste 0.50; Sand No. 2 1.50	W	1	26.7	1	471	
30	Roman cement 1; Lime in paste 0.50; Sand No. 2 1.50	D	1	29.1	1	787	
31	Lime in powder 1; Sand No. 3 3.50	W	3	12.3	1	159	
32	Lime in powder 1; Sand No. 3 6	W	1	5.6	1	107	
33	Lime in paste 1; Sand No. 3 .50	W	1	14.3	1	208	
34	Lime in paste 1; Sand No. 3 1.50	W	3	15.4	2	275	
35	Lime in paste 1; Sand No. 3 3	W	4	12.8	2	146	Made with a hoe.
36	Lime in paste 1; Sand No. 3 2.50 *a* 3	W	6	14.3	3	202	Made in mortar mill.
37	Lime in paste 1; Sand No. 3 2.50 *a* 3	D	5	14.9	4	254	do. do.
38	Lime in paste 1; Sand No. 1 2.50 *a* 3	W	1	13.7	1	217	do. do.
39	Lime in paste 1; Sand No. 1 2.50 *a* 3	D	1	16.2	1	200	do. do.
40	Lime in paste 1; Sand No. 1 2	W	1	33.8	1	242	Lime different.
41	Lime in paste 1; Sand No. 1 2	D	1	26.6	1	231	

Observations on the Experiments of Table No. LXV.

1st. Generally, within the limits of the experiments, *a mortar made of lime and sand, or of hydraulic cement and sand, or of hydraulic cement, lime and sand—whether it was cement A, or cement B, or Roman cement, was the stronger, as the quantity of sand was the less.* In 24 comparisons, 3 exceptions.

In 13 comparisons of *tenacity*, 2 exceptions.

In 11 comparisons of *hardness*, 1 exception.

2nd. *It appears that with cement A, or cement B, any addition of sand weakens the mortar.* In all the cement experiments, except one, composed of Roman cement 1—sand ½ (No. 26,) the cement alone, was stronger than when mixed with sand in any proportion whatever. Cement A (No. 6,) would seem to be another exception, but it is not; the strength of cement A, alone, as given in No. 2, is the average of five results with different specimens of cement, some of which were of inferior quality; while the result given in No. 6 is of one trial only, and that of a cement proving to be the best used; the particular result of No. 2 which corresponds with No. 6—that is to say, which was afforded by the same specimen of cement, gave for *tenacity* 74.7 lbs. and for *hardness* 1063 lbs., while No. 6 shows a *tenacity* of 61.9 lbs. and a hardness of 1055 lbs.

3rd. *It appears that when cement mortars are not required to be the strongest that can be made—a little lime may be added, without great loss of tenacity, and, of course, with a saving of expense.*

4th. *Mortar made in the mortar-mill was superior to mortar made by being mixed, in the common mode, with the hoe.*

5th. *When the bricks were dry and the mortar more fluid than usual, the mortar was better, both as to* TENACITY *and* HARDNESS—*in five cases out of seven, than when the bricks, being wet, were put together with mortar of common consistence.*

In the next table there is a comparison of the three kinds of lime—of the three modes of slaking, of various proportions of sand—of the effect of wet and of dry bricks on the mortar, &c.

In most cases six pairs of bricks were put together at the same time, and of the same materials; of which three pairs were separated after about 6 months, and the remainder after the lapse of 4 years and 5 months.

Table No. LXVI.

Showing the tenacity and hardness of mortars variously composed after exposure in the air.

No.	Nature and composition of the mortar.		Bricks wet.				Bricks dry.				Remarks.
			Tenacity per square inch.		Hardness.		Tenacity. per square inch.		Hardness.		
			After 6 months.	After 4 years and 5 months.	After 6 months.	After 4 years and 5 months.	After 6 months.	After 4 years and 5 months.	After 6 months	After 4 years and 5 months.	
			lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	
1	*Paste of Smithfield lime slaked by* DROWNING Sand No. 2	1 1	20.4	42.8	119	220					There are two kinds of Fort Adams lime in the table. The first, A, was imperfectly calcined: the second B, was thoroughly burned.
2	Lime the same Sand No. 2	1 2	15.2	18.8	130	297					
3	Lime the same Sand No. 2	1 3	12.6	16.6	182	232					
4	Lime the same Sand No. 2	1 4	13.2	16.4	85	203					
5	*Paste of Thomastown lime slaked by* DROWNING Sand No. 2	1 1	11.3	38.3	216	300		40.3		355	
6	Lime the same Sand No. 2	1 2	17.1	38.3	123	273		39.1		310	
7	*Paste of Thomastown lime, slaked by* DROWNING Sand No. 2	1 3	24.7	27.6	265	240		38.0		220	
8	Lime the same Sand No. 2	1 4	15.1	21.7	214	210		35.4		203	
9	*Paste of Fort Adams lime* A *slaked by* DROWNING Sand No. 2	1 1	13.4	21.9	105	273		34.0		186	
10	Lime the same Sand No. 2	1 2	9.9	18.8	68	175		22.5		110	
11	Lime the same Sand No. 2	1 3	12.6	22.7	75	93		22.8		187	
12	Lime the same Sand No. 2	1 4	9.6	11.5	92	93		21.4		102	
13	*Paste of Thomastown lime, slaked by* SPRINKLING Sand No. 2	1 1	26.8	49.1	259	798		40.6		787	
14	Lime the same Sand No. 2	1 2	26.4	35.6	225	666		57.3		370?	
15	Lime the same Sand No. 2	1 3	26.3	37.0	285	392		26.2		625	
16	Lime the same Sand No 2	1 4	25.2	31.0	289	313		38.0		347	
17	*Paste of Fort Adams lime* B *slaked by* SPRINKLING Sand No. 2	1 1	32.9	47.8	446	900		56.7		620	

Table No. LXVI. Continued.

No.	Nature and Composition of the mortar.		Bricks wet. Tenacity per square inch. After 6 months.	Bricks wet. Tenacity per square inch. After 4 years and 5 months.	Bricks wet. Hardness. After 6 months.	Bricks wet. Hardness. After 4 years and 5 months.	Bricks dry. Tenacity per square inch. After 6 months.	Bricks dry. Tenacity per square inch. After 4 years and 5 months.	Bricks dry. Hardness. After 6 months.	Bricks dry. Hardness. After 5 years and 5 months.	Remarks.
			lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	
18	Lime the same Sand No. 2	1 2	33.1	54.5	228	600		52.4		507	
19	Lime the same Sand No. 2	1 3	28.9	43.1	221	327		51.8		266	
20	Lime the same Sand No. 2	1 4	23.5	30.4	254	258		52.6		233	
21	*Paste of Smithfield lime* AIR SLAKED Sand No. 2	1 1		22.4		126					
22	Lime the same Sand No. 2	1 2		9.9		85					
23	*Paste of Thomastown lime* AIR SLAKED Sand No. 2	1 1				37?					
24	Lime the same Sand No. 2	1 2		6.0		20?					
25	*Paste of Fort Adams lime* B AIR SLAKED Sand No. 2	1 1		29.2		664					
26	Lime the same Sand No. 2	1 2		21.6		281					
27	*Paste of Fort Adams lime* B *slaked by* DROWNING Brick dust Sand No. 2	1 0.40 1.40	16.3		104						
28	Lime the same Dust of burnt clay Sand No. 2	1 .50 .50	17.5		168						
29	*Paste of Thomastown lime slaked by* SPRINKLING Brick dust	1 2	35.0		360						
30	*Paste of Thomastown lime slaked by* DROWNING, measured before slaking Sand No. 2	1 5	12.2	18.5	102	263		22.5		192	
31	Lime the same* Cement A Sand No. 2	1 .33 5.50	15.4	23.1	165	192		42.6		230	*Equal, lime 1 Cement 0.33 Sand 5.00 do. 50 Lime 1 Cement 0.33 Sand 5.50
32	*Paste of Fort Adams lime* B *slaked by* DROWNING, measured before slaking Sand No. 2	1 5	25.7	48.8	130	650		17.8		652	
33	Lime the same* Cement A Sand No. 2	1 .33 5.50	22.7	46.7	194	849		46.2		303	
34	Cement A in powder Sand No. 2	1 1.50	63.3	72.4		1508	467	88.4		1659	

Observations on the experiments of Table No. LXVI.

1st. *Within the limits of the experiments, whatever was the mode of slaking, or the kind of lime, the mortar was the stronger as the quantity of sand was less.*

The lime being measured in paste, the proportions were 1 of lime to 1 of sand; 1 of lime to 2 of sand; 1 to 3, and 1 to 4 of sand.

In all the corresponding trials of the table,

1 lime in paste, to 1 sand, gave the strongest mortar in 35 cases of tenacity, and in 13 cases of hardness.

1 lime in paste, to 2 sand, gave the strongest mortar in 3 cases of tenacity, and in 1 case of hardness.

1 lime in paste, to 3 sand, gave the strongest mortar in 2 cases of tenacity, and in 2 cases of hardness.

1 lime in paste, to 4 sand, gave the strongest mortar in 0 cases of tenacity, and in 1 case of hardness.

2d. *Slaking by* DROWNING, *or using a large quantity of water in the process of slaking, affords weaker mortar than slaking by* SPRINKLING.

In 24 corresponding cases of the table—The quantity and quality of the materials being alike: and there being no other difference than in the modes of slaking the lime.*

Lime slaked by SPRINKLING, gave the best mortar in 22 cases of tenacity, and in 24 cases of hardness.

Lime slaked by DROWNING, gave the best mortar in 2 cases of tenacity, and in 0 case of hardness.

The average strength in all the 24 cases in which the lime was slaked by *drowning* was, as to tenacity, 23.79 lbs., and as to hardness, 187.00 lbs.

While the average strength in all the 24 cases in which the lime was slaked by *sprinkling* was, as to tenacity, 38.63 lbs., and as to hardness 417.33 lbs.

The relative tenacity then is as 1 to 1.62; and the relative hardness as 1 to 2.23.

3d. *The experiments with air* SLAKED LIME, *were too few to be decisive—but the results were unfavourable to that mode of slaking.*

Average strength of the mortar made of *air-slaked* lime as to tenacity 20.80 lbs., and as to hardness 202.18 lbs.

Average strength of the corresponding mortars made of lime slaked by *drowning*, as to tenacity 27.10 lbs., and as to hardness 207.50 lbs.

Average strength of the corresponding mortars made of lime slaked by *sprinkling*, as to tenacity 46.70 lbs., and as to hardness 533.83 lbs.

4th. *The mortars were very materially stronger at the end of* 4 *years and* 5 *months, than at the end of the first half year.*

Of the 26 mortars which enter into this comparison, the average strength at the end of 6 months was, as to tenacity, 22.54 lbs., and as to hardness 166.33 lbs., and at the end of 4 years and 5 months it was, as to tenacity, 35.45 lbs., and as to hardness 367.37 lbs.

The relative tenacities being as 1 to 1.57, and hardness as 1 to 1.97 lbs.

5th. *Brick dust, or the dust of burnt clay, improves the quality of mortars both as to tenacity and hardness.*

6th. *Hydraulic cement added, even in small quantities, to mortars, improves their quality sensibly.*

* Except in their being two different burnings of Fort Adams lime

7th. ***The tenacity of mortars seems to have been increased by using dry bricks, and making the mortar a little more fluid than usual. But the hardness of the mortars was rather the greatest when*** WET BRICKS ***were used.***

In 21 corresponding instances, *wet bricks* and mortar of common consistency gave the best results, as to tenacity, in 5 instances; and, as to hardness, in 12 instances. *Dry brick* and mortar more fluid, gave the best results as to tenacity in 16 instances; and as to hardness, in 9 instances.

Table No. LXVII.

Trials in December, 1836, of mortars made in December, 1835. The results show the weights in pounds required to break prisms of mortar 2 inches square, 6 inches long and 4 inches in the clear between the supports.

				Lime from the same barrel.									Lime from the same barrel.			
No. of the comparison.	Sand No. 2.	Lime {slaked to powder with 1-3 of its bulk of water, measured in paste.	Cement A, cask No. 1, measured in paste.	Mortars made with the least possible quantity of water.	Mortars made rather thin.	Mortars made with equal parts of water and bitter-water.	Mortars made with bitter-water alone.	Mortars made of cement A, cask No. 2, which required much more time to set under water than cask No. 1.	Mortar made of calcined clay instead of cement A, cask No. 1.	Mortar made of sand No. 4, instead of sand No. 2.	Lime slaked with water enough to make a thin paste—and made into mortar after 12 hours. Stone Lime.	Shell Lime	Lime slaked with ¼ its bulk of water, after being kept sealed hermetically in a jar 3 months.	Lime slaked to cream at first, and kept in that state in a keg under ground for 3 months.	Lime allowed to slake spontaneously for 3 months.	Lime slaked to powder with 1-3 its bulk of water and kept dry in a tight keg for 3 months.
1	1		½	497	370	323										
2	1		¾	562	502											
3	1		1	655	525	703	206									
4	1		1¼	782	516											
5	1		1½	707	721	1125	483									
6	1		1¾	783	712											
7	1		2	844	694	984	452									
8	1	1	¼		117			103	115	197						
9	1	⅓	½		351		220									
10	1	1	½		155			164	178	211						
11	1	1	¾		337			173	155	412						
12	1	½	1		469		295									
13	1	1	1		426			178	206	328						
14	1	1	1¼		328			305	187	469						
15	1	1	1½		295		295	267	206	426						
16	1	1	1¾		337			305	206	351						
17	1	1	2					548		511						
18	1	1	3		417		454	455								
19	1	1	4		389		455	520		806						
20	1	1	5		492		548	530		633						
21	1	1	6		576		553	649		862						
22	1	1									206	141	401	286	253	286
23	2	1									155	129	412	225	244	
24	3	1									122	173	356	160	159	244
25	4	1									131	89	286	169	150	220

Observations on Table No. LXVII.

It results from this table, and from the tables from which it has been abridged,

1st. *That in mortars of cement and sand (no lime) the strength is generally greater as the quantity of sand is less.* In 33 comparisons, 12 exceptions.

2nd. *That in mortars of sand, cement and lime—the lime remaining the same in quantity, the mortars were stronger as the quantity of sand was less in proportion to the cement.* In 57 comparisons, 10 exceptions.

3rd. *That in mortars of cement, sand and lime—the quantities of cement and sand being the same—the mortars were stronger as the quantities of lime were less.* In 52 comparisons, 15 exceptions.

4th. *That mortars made of cement and sand were materially stronger when the least possible quantity of water was used, than when the mortars were made thin.* In 14 cases, 1 exception.

5th. *That mortars made of cement and sand with the least possible quantity of water, were stronger when kept in a damp place, than when kept in a dry one.* In 7 comparisons, 1 exception. The experiments did not prove this to be true with reference to mortars made thin. These results were afforded by the experiments but are not included in the above table.

6th. *That in mixtures of lime and sand in various proportions, the mortar was generally stronger as the lime was slaked with less water.*

The average strength of several trials with 0.30 of water being represented by 80—with .40 of water, it was 98—with .60 of water, it was 72—with .80 of water, it was 60, and with 1.00 of water, it was 57. These results were afforded by the experiments, though not included in the table.

7th. *That mortars of lime and sand are materially improved by the addition of calcined clay, but not so much as by the addition of cement A.*

8th. *That sand freed from dust by washing and then pounded fine, gives much better mortars, than a sand composed of particles of every size from dust (no dirt) up to grains $\frac{1}{12}$ of an inch diameter.* In 21 comparisons, 2 exceptions.

9th. Many experiments were made to ascertain whether of two cements of the same manufactory, the difference being, probably, only difference of age, that cement which sets the quickest under water will give the strongest mortars in the air after a considerable lapse of time. The results leave the matter in doubt. The quick cement sometimes giving stronger mortars, and sometimes weaker.

10th. Of lime kept for three months after being slaked, before being made into mortar—the lime slaked into powder by sprinkling one-third of its bulk of water, gave the strongest mortar—represented by 250 lbs.; the lime slaked into cream gave the next strongest mortar—represented by 210 lbs., and the lime slake spontaneously during three months, the weakest mortar, represented by 202 lbs. All these mortars being much inferior to that made of the same lime which had been carefully preserved from slaking by being sealed hermetically in a jar—this last mortar being represented by 364 lbs. It must be remarked here that this result is very extraordinary for fat lime and sand; and it is probable this particular barrel of lime was somewhat hydraulic.

11th. Mortars of cement and sand in which bitter-water alone was mixed (Bitter-water being the mother water after the separation of muriate of soda from sea-water,) were weaker than those in which water, or a mixture of equal parts of water and bitter-water, was used. But a mixture of equal parts of water and bitter-water gave much better mortar than water alone—the strongest composition we had, being cement $1\frac{1}{2}$, sand 1, and equal parts of water and bitter-water. In 8 comparisons, 2 exceptions.

The trials that afforded the two exceptions were with mortars containing a smaller proportion of cement than the six others. These facts seem to show that the addition of bitter-water, within certain limits, improves the cement, but that beyond these limits it is injurious; and that where the proportions of cement are great, an increased addition of bitter-water may be advantageous. These particular experiments were made in consequence of finding that the addition of a little bitter-water hastened the setting of cement A when immersed.

12th. *Mortars of cement and sand are injured by any addition of lime whatever, within the range of the experiments; that is to say from sand* 1, *lime* $\frac{1}{8}$, *and cement* $\frac{1}{8}$; *to sand* 1, *lime* 1, *and cement* 2. No exceptions in 67 comparisons.

13th. *Stone-lime, in the proportions tried, gives better mortar than shell-lime, as* 153 *to* 133: but some previous trials had afforded results slightly the best with shell-lime.

Table No. LXVIII.

Trials made in June, 1836, *of mortars made in September,* 1835.

The results show the weights, in pounds, required to separate each inch square of surface of bricks joined by mortars. The object is to compare grout with mortar.

No. 1.	Sand No. 2.	Lime slaked to powder and measured in paste.	Cement A.		Mortar.	Grout.
1	2	1		Lime and cement the same.	30.12	17.19
2	2	1	$\frac{1}{8}$		33.33	17.84
3	2	1	$\frac{1}{4}$		31.35	15.13
4	2	1	$\frac{1}{2}$		32.14	25.14
5	2	1	$\frac{3}{4}$		41.06	21.42
6	2	1	1		39.64	34.68
7	2	1		Lime and cement the same.	22.94	23.08
8	2	1	$\frac{1}{8}$		23.38	14.22
9	2	1	$\frac{1}{4}$		27.07	12.67
10	2	1	$\frac{1}{2}$		29.93	16.96
11	2	1	$\frac{3}{4}$		33.79	22.71
12	2	1	1		36.69	19.75

Observations on Table No. LXVIII.

In order to compare the strength of grout with that of mortar, bricks were joined (as before described) with the mortar given in the table—there being 4 pairs to each kind of mortar. To obtain similar joints of grout, bricks were supported on their ends and edges, in a box large enough to contain all, in such a way as to admit the proper quantity of grout to flow in between each pair. The box was not disturbed until the grout had become quite stiff, when it was first laid on one side, and then taken to pieces. The excess of grout was carefully cleared away from the bricks, which were removed without injury to any of the pairs, and put away by the side of the bricks joined with mortar.

It will be seen that, in every case but one, the grout was much inferior

to the mortar. The average strength of all the mortars in the table is 31.78, and the average strength of all the grouts is 20.06

Changes of bulk on slaking lime—making mortar, grout, &c.

A great many measurements were made of the changes of bulk in the operations of slaking, lime, making mortars &c., and the results, as might be expected, varied with the qualities of the lime. The following condensation of the results may be useful.

					trials.	varying from
1 lime and	$\frac{1}{3}$	water made, as a mean,	2.25	of powder.	27	1.56 to 2.97
1 do.	$\frac{2}{3}$	do. do.	1.74	do.	4	1.55 to 1.83
1 do.	$\frac{3}{4}$	do. do.	1.81	do.	4	1.63 to 1.95
1 do.	1	do. do.	2.06	do.	4	1.77 to 2.39
1 do.	2.54	do. do.	2.68	of thin paste.	3	2.50 to 2.82
		Slaked by drowning.				
1 do.	1.70	do. do.	1.98	do.	6	1.73 to 2.36
		Slaked by sprinkling.				

Lime in powder.	Water.				
1	0.40	made, as a mean,	0.66 thick paste.	2	0.65 to 0.67
1	0.50	do. do.	0.76 thinner paste.	19	0.67 to 0.94

1 lime air-slaked gave, as a mean, 1.84 powder 3 1.37 to 2.41

1 of air slaked lime in powder and 0.50 water made, as a mean, 0.75 thin paste, 2 trials varying from .70 to .80.

1 of lime (quick) pounded to powder, made 0.90 of powder, 1 trial.

1 of lime slaked to powder, kept dry for 3 months, still measured 1.00, 1 trial.

Sand.	thin paste.	cement.		mortar.	trials.	varying from.
1	52	00	made, as a mean,	1.17	13	1.06 to 1.21
1	58	0.125	do.	1.25	23	1.70 to 1.50
1	55	0.25	do.	1.37	3	1.29 to 1.54
1	61	0.35	do.	1.43	3	1.38 to 1.57
1	72	0.50	do.	1.60	2	1.50 to 1.70
1	1.00	0.125	do.	1.78	1	
1	1.00	0.25	do.	1.85	1	
1	1.00	0.50	do.	2.18	1	
1	1.10	0.75	do.	2.14	1	
1	1.40	0.25	do.	2.20	1	
1	1.28	1.00	do.	2.36	1	
1	1.00		do.	1·71	1	
1	2.00		do.	2.14	1	

1	50	00	do.	0.32	water,	made	1.27	grout.
1	50	0.062	do.	0.45	do.	do.	1.50	do.
1	50	0.125	do.	46	do.	do.	1.55	do.
1	50	.25	do.	51	do.	do.	1.66	do.
1	50	.375	do.	52	do.	do.	1.78	do.
1	50	.50	do.	61	do.	do.	1.88	do.

202	of mortar with	87	of water	made	290	of grout.
213	do.	87	do.	do.	305	do.
430	do.	180	do.	do.	604	do.
467	do.	201	do.	do.	660	do.
430	do.	180	do.	do.	620	do.

495 of mortar with	176 of	water made		664	of grout.
553	do.	180	do.	do.	711	do.

Article xxiv.—*Observations and experiments on Concrete, &c.*

It was ascertained, by careful measurement, that the void spaces, in 1 bulk of sand No. 1, taken from the middle of the heap, amounted to 0.33: the cementing paste, whatever it may be, should not be less therefore, than one-third the bulk of this sand. Taking one bulk of cement A, measured in powder from the cask, and a little compacted by striking the sides of the vessel, water was added till the consistence was proper for mortar: 0.35 of water was required to do this, and the bulk of the stiff cement paste was 0.625. To obtain, at this rate, an amount of cement paste equal to the voids (0.33) in the sand, will require, therefore, 0.528 cement in powder, and 0.185 of water, or

Dry sand,	1.000	making a bulk of 1.000 of mortar.
Cement in powder,	.528	
Water,	.185	

It is by no means certain that a mortar composed on this principle will be the most tenacious that can be made—on the contrary our experiments indicate that the mortar would be stronger with a smaller proportion of sand; but possessing the minimum quantity of cementing constituent, which is by far the most expensive ingredient, it affords the cheapest admissible mortar, made of cement and sand; and as it was probable, that it would shrink very little on drying, it was tried as a *pointing* for exposed joints, and also as *stucco*, and it answered very well for both purposes—becoming very hard, and never showing the slightest crack. An excess of cement, and a very *slight excess of water*, above the stated proportions, should be allowed for imperfect manipulation, because the proportions suppose every void to be accurately filled.

Extending the application of this principle to concrete—experiment showed that one bulk of stone fragments (nearly uniform in size, and weighing about 4 oz. each) contains 0.482 of void space. To convert this bulk of stones into concrete, we, in strictness, need use no more mortar than will fill this void space; and to compose this mortar we need use no more cement than is necessary to occupy, in the state of paste, the voids in 0.482 of sand. This concrete would therefore be composed as follows:

Stone fragments about 4 oz. each,	1.000	making a bulk of 1.000 of concrete.
Sand No. 1 . .	.482	
Cement in powder, .	.255	
Water, . .	.089	

Obtaining thus a cubic yard of concrete by the use of one-fourth of a cubic yard of cement in powder, (about one and a half bbls.)

But the above fragments were of nearly equal size, and of a form approaching the spherical: affording more void space than if they had been more angular, and had varied in size from about six oz. to less than one oz. such as would commonly be used. We have found that clean gravel, quite uniform in the size of the pebbles, which were about half an inch in average diameter, afforded voids to the amount of 0.39. And Mr. Mary, a French Engineer, used pebbles, probably mixed of coarse and fine, of which the voids were 0.37. The above allowance of 0.482 for void space is therefore quite large.

In all cases of the composition of concrete, the quantities expressed above, should be ascertained by actual measurement of the particular cement, sand and fragments, or pebbles, that are to be used. No better mode of measuring the void spaces, will be found, probably, than measuring the quantity of water that can be poured into a vessel already filled with stone fragments, pebbles, or sand, as the case may be.

Although the hydraulic property of cement will be the cause, in all cases of its use in concrete, it may happen that the cement at hand is more energetic than is actually necessary, and that the concrete would fully accomplish the object in view, even if it should be two or three weeks in becoming hard and impervious to water. Under such circumstances lime may take the place of part of the cement, with great economy. The lime may be added either in the state of powder that has been slaked some time, or in the state of paste: but in either case, the previous slaking must be complete.

The mortar is to be made first, and then the pebbles, or broken stones, may be mixed therewith by turning them over several times with the shovel.

When it is to be deposited under water, it is still a disputed point whether the concrete, prepared as above, should be used immediately, or be left in heaps to stiffen to such a degree as to require the use of pickaxes to break down the heaps: but, in works out of water, there can hardly be a case in which it will not be best to place it at once in its allotted space, where it should be compacted by ramming till none of the stone fragments project above the common surface. One or two trials will show how much mortar over and above the strict proportion is necessary in each case.

In circumstances where ramming cannot be applied, as when depositing concrete in deep water, the concrete should be more yielding and plastic —containing a larger proportion of mortar, and the mortar should be rammed before being deposited, in order thoroughly to imbed the larger constituents.

In many situations where concrete may be resorted to with great advantage, the economy need not stop at the above proportions. This substance may be rammed between, and upon, stones of considerable size—the only indispensable precaution being, to make sure that the stones are perfectly clean, are well imbeded in the concrete, and are far enough apart to permit the full action of the rammer between them.

The following case occurred at Fort Adams in October, 1836.

The proportions adopted were, *fragments of granite*, of

nearly uniform size, and about 5 oz. each,	1.000	Bulk of concrete, a little more than 1.000.
Sand No. 1	0.500	
Cement A, in powder,	0.280	
Water rather more than	0.100	

Experiment gave 16.683 as the number of cubic feet of concrete made by 1 barrel of cement—187 barrels were consumed which afforded 115.52 cubic yards of concrete. There were also used, 11.29 struck Winchester bushels of sand, and 22.58 struck Winchester bushels of granite fragments.

187 barrels of cement at $2.45	$ 458.15
1129 struck bushels of sand at $0.37	41.77
2258 do. granite fragments at $0.04	90.32
Carried over,	$ 590.24

Brought over,	$ 590.24

There were 151 days labour, applied to making mortar—making concrete—depositing the concrete in its proper place, ramming it into a compact mass, and doing all other work required in the operation.

151 days at $ 092.	138.92
Supervision	10.00
Cost of 115.52 cubic yards,	$ 739.16

Cost of one cubic yard $ 6.40

Springs of water flowed over this work continually; and were allowed to cover each day's work. The next morning the concrete was always found hard and perfectly set.

Had we dispensed with one half of the cement used, and used in lieu thereof, as much paste of lime, as the cement dispensed with would have furnished of paste of cement, the cost would have been materially reduced, and the work have been still very hydraulic, and very strong. In that case, the bulk would not have been altered, but would have been as before, 115.52 cubic yards. We should have used $93\frac{1}{2}$ bbls. of cement less than we did: and, as cement, in passing to the state of paste, diminishes in bulk in the proportion of 1 to .625, we should have used $93.5 \times .625$ equal to 58.43 barrels of paste of lime. Saving, thereby, the difference between the cost of 93.5 barrels of cement and 58.43 barrels of paste of lime.

93. 5 barrels of cement at $ 2.45	$ 229.07
58.43 do. of paste of lime at $ 0.60	36.06
Amount saved	$193.01

$ 739.16, less $ 193.01, equal $ 546.15; the cost of 115.52 cub. yards.

Cost of one cubic yard $ 4.73.

Another Instance.

Proportions—Clean gravel,	1.000	Bulk of concrete about 1.15
Sand No. 1,	.530	
Cement A, in powder,	.430	
Water about,	.140	

This was rammed into a mould of the capacity of 13.786 cubic feet.

Cement A,	4.35 struck bushels at	$ 0.59	cost	$ 2.57
Sand No. 1, washed	5.44 do.	" 0.04		.22
Gravel	10.00 do.	" 0.04		.40
Cost of all the labour,				1.03
Total cost of 13.786 cubic feet,				$ 4.22

Being $ 0.306 per cubic foot, or $ 8.26 per cubic yard.

This became very hard, and is a very good substitute for stone, in certain applications.

Another Instance.

Proportions—Clean gravel,	1.000
Sand No. 1,	.625
Cement A, in powder,	.333
Water, about	.125

This was rammed into a mould of the capacity of 7.812 cubic feet; and the whole cost was $ 2.15, being $ 0.276 per cubic foot, or $ 7.45 per cubic yard.

This became a hard mass, but the concrete was rather too incoherent to make the best factitious stone.

Another case.

In this instance, a box containing 7.812 cubic feet was filled, first, with pieces of a stone of slaty structure—laying the pieces on their beds; a grout was then poured in, until all the interstices were filled. The composition of grout was as follows.

Washed sand No. 1,	1.000
Cement A in powder,	1.000
Water,	.910

The whole cost was \$2.40—being \$0.31 per cubic foot—or \$8.37 per cubic yard.

This mass became hard, but was not so strong as those made of mortar instead of grout.

Numerous objects have, at different times, been moulded at Fort Adams, with analogous compositions, and always with success. Sometimes concrete was used, the entire mass being rammed into the mould: at other times the mortar without the fragments was used *as mortar*; bricks, or fragments of stones, being laid therein, in successive strata, until the mould was filled. Shafts of columns—the Doric echinus, abacus, &c., thus formed many years ago, resist the climate well, although less perfect than we should now be able to produce.

All our experiments concur in showing that much sand weakens cement mortar essentially; at least when exposed to the air. The improvement to be applied to the foregoing proportions should consist therefore, if the expense be no objection, in increasing the quantity of cement—taking care to keep the quantity of water as low as possible, in order to retain the shrinkage of the indurated mass at a minimum. It is surprising how much water may be driven out of an incoherent and apparently half-dry heap of cement-mortar, by hard ramming: and it is still more surprising, after the exact quantity necessary to saturation has been supplied, how small a quantity of water will suffice to convert a dry and powdery heap, if well worked, into a thin paste. Cements vary in their capacity for water: hence the dose of water is a matter that must be established by experiment in each case. The true quantity for concrete, and moulded objects in air, is that which, with hard ramming, affords a stiff paste, with a *little* free water on the surface: a state to which it can be brought with difficulty under the trowel or under the shovel. More water than this is attended with the double disadvantage of lessening the density of the mortar when dry, and of causing cracks by the shrinkage. If the quantity of water be thus regulated, the quantity of cement may be increased at pleasure, but the expense will increase rapidly with every addition of cement. In the first concrete above, the bulk of the dry cement is about one half the bulk of the sand, and the expense per cubic yard is \$6.40; make the dry cement to equal the sand in bulk, and the expense per cubic yard will be about \$10.00, all other proportions remaining, as they ought, the same.

In the preceding proportions it has been supposed that the concrete was to be used in the air, and that nothing would prevent the free use of the rammer. But if the concrete is to be deposited under water beyond the reach of this instrument, there should be a change of the proportions; and the quantity of mortar should be so increased that the fragments will be certain to be severally imbedded therein from their own weight, the gentle operation of the rake and other leveling instruments, and the pressure of the superincumbent concrete. Attention must be paid to the constituents

of the mortar, in reference to hydraulic energy, also, especially in running water: this mortar must not only be very hard after a time—it must become hard speedily; and to attain this end, the materials at command may demand proportions quite different from those required to fill the voids in the sand.

The following instances are derived from the practice of the French.

M. Mary, Engineer des Ponts et Chausseés, states that he ascertained the voids between the stones to be .37 of the whole bulk—that filling .90 parts of a box with stones, .10 parts+(.37×.90=.33)=.43 parts of mortar would be required, in theory, to fill the box: but he found that the box was more than full, showing that some of the mortar designed to occupy the voids did not reach them, from imperfect manipulation. Instead of .90 parts, he then filled .87 parts of the box with stones, which required that the mortar should amount to .13+ (.37×.87=.32) =.45 parts of mortar; and this he found filled the box very exactly. He also found that the transportation of the concrete, in wheelbarrows, from the mortar bed to the place where it was to be deposited, produced agitation enough to settle all the stones to their places, and bring the excess of mortar to the top. M. Mary is not aware that so large a proportion of stones had been employed any where else than at Pont-de-Remy, at Abbeville, and at the upper dam of Saint Valery; but at these places, no disadvantage resulted from the quantity, and the concrete was impervious to water. The mortar mixed with these stones was composed of 0.22 parts of feebly hydraulic lime measured in paste—0.225 of sand—and 0.225 of brick, or tile, dust ("*cement.*") The proportions of this concrete were therefore, as follows:

Stones,	.87	Total bulk 1.000
Sand,	.225	
Brick, or tile dust,	.225	
Feebly hydraulic lime in paste	.22	
Water,		

Or—

Stones,	1.000	1.15
Sand,	.259	
Brick or tile dust,	.259	
Feebly hydraulic lime in paste,	.253	
Water,		

At the lock of Haningue the cube of concretes was composed as follows:

Pebbles,	.69	Bulk 1.00
Sand,	.40	
Hydraulic lime in paste,	.22	
Water,		

As to this case M. Mary observes that it is probable the pebbles were a mixture of coarse and fine gravel; because, with these quantities, in order to make up the cube of 1.00, the void spaces could amount to only about .09. This would be about 13 per cent. only of the measure of the pebbles, instead of 37, found by M. Mary, himself, in the case stated above. Expressing, as in the other cases, the proportions used at this lock, in parts of the measure of pebbles—it would stand thus,

Pebbles,	1.00	Bulk 1.45
Sand,	.58	
Hydraulic lime in paste,	.32	

To found the pier of the suspension bridge communicating between la Grève and l'ile de la Cité, at Paris, a concrete was used which was much more hydraulic than those just mentioned. It was thus composed:

Fragments of Buhrstone,	1.00	Resulting bulk 1.50
Sand,	.50	
Factitious puzzolana of M. St. Leger,	.25	
do. hydraulic lime do. (unslaked)	.25	
	2.00	

This concrete was placed in a bed eight feet thick, which, owing to a flood in the Seine, was about six weeks in being deposited. Masonry was begun upon it in eight days after its completion, and in six weeks it had the whole, pier to support; and before the concrete was four months and a half old it sustained the weight of the pier of the bridge, and of the proof load, without the least appearance of subsidence.

At the Saint Martin canal, where great quantities of concrete were used, the proportions were:

Pebbles,	1.00	Bulk 1.63
Sand,	1.00	
Hydraulic lime,	.33	

In another case, these proportions were used, viz:

Silicious pebbles,	1.00	Bulk 1.34
Tile dust and brick dust,	.28	
Fat lime made from chalk used at the moment of slaking—measured as quicklime,	.56	
Water, more or less,	.53	

Another case.

Rounded gravel about the size of a hazle-nut,	1.000	Bulk 1.15
Mortar,	0.500	

The mortar being composed of brick-dust,	1.00
Slaked lime, in powder,	1.00
Sea-sand,	1.00

After three months immersion in salt water, this concrete sustained a pressure on one end of the mass of 260,000 pounds per square foot of surface without impression. On being broken up, it showed that the gravel was well imbedded in mortar. The void space in the gravel was found to measure 0.35.

Another.

The aqueduct of Guétin, which conducts the Loire canal across the Allier, is composed of 18 arches of $53\frac{1}{2}$ feet span, and of 17 piers of 9.84 feet in thickness. Immediately at one end of the aqueduct are three connected locks, whereof the mass forms the left buttress of the bridge.

The right buttress and its wing-walls, the 17 piers, and the three connected locks, are built on a general "*radier*" or platform, 1594 feet long, 57.42 feet wide, and 5.41 feet thick; on the upper and lower sides of the platform are two guard walls 6.56 feet thick, and 14.76 feet deep—these walls, like the rest of the platform, rising to within 1.64 feet of the level of the water in the river in its lowest state.

The whole of the guard walls, as well as the lower layer of the platform,

for a thickness of 3.28 feet, were formed of concrete deposited in the water. The concrete used amounted to near 22.000 cubic yards.

The operation of depositing the concrete was confined to the 4 or 5 months between the spring and autumn floods; and at the end of the second season it supported the superstructure above described.

The following is the composition of the concrete:

Stone fragments,	1.000
Mortar,	1.000

The mortar was composed of sand,	1.50
Hydraulic lime measured in powder,	1.00
Artificial puzzolana of M. St. Leger,	0.50

And the puzzolana was formed by calcining, at a heat not great, a mixture of four parts of earthy clay measured in paste, and one part of fat lime measured in the same way—the mixed pastes being formed into small prisms, dried in the sun, calcined and pulverized.

In order to obtain some evidence of the actual strength of concrete, and to compare several varieties of composition, the experiments contained in the following table were made at Fort Adams: some prefatory remarks are necessary in relation to them.

The *cement* was obtained by taking several casks of hydraulic cement A, of nearly equal energy—emptying them into one heap on the floor, and, after mixing the contents intimately, returning the cement into the casks and heading them all tightly, until they were severally wanted. As the casks were opened, in succession, for use, the quality of the mixture was tried with the test wire, and was found to be very uniform—about half an hour being required for the setting. This cement had been on hand about four months.

The *lime* used was Fort Adams' improved lime. It was slaked to powder by the affusion of one-third its bulk of water, and allowed to stand several days. As it was about to be used, it was reduced to paste and passed through a hand paint-mill, by which it was made very fine. It should be borne in mind that this lime is slightly hydraulic.

The *sand* used was sand No. 1

The larger constituents of the concrete were of four kinds, viz: 1st. *granite fragments,* angular, average weight of each 4 oz.; 2d, *brick fragments,* angular, average weight 4 oz.; 3d. *stone-gravel,* made up of rounded pebbles from ½ to ¾ of an inch in diameter; and, 4th. *brick gravel,* composed of angular fragments of bricks from ½ to 1 inch in their greatest dimensions. All were perfectly free from dirt, and were drenched with water before mixing them with the mortar.

The measure of the void spaces in the granite and brick fragments was .48; and of the stone gravel and brick gravel, .39.

One set of experiments was made by using, in each case, a measure of mortar equal to the measure of void space—and another set, by using two such measures of mortar.

The mortar was made with as small a quantity of water as possible. On this account, the mixture of the constituents was probably somewhat imperfect; and to this may, in part, be attributed the irregularities observable in the results. The concrete, before ramming, was quite incoherent, especially when only one measure of mortar was used. It was, in every case,

consolidated by ramming into boxes that afforded rectangular prisms of concrete 12 inches by 6 inches by 6 inches.

The prisms were made in December 1836, and being kept in a damp place, safe from frost and accident, were broken in June, July, and August following. In breaking the prisms the two edges of the supports were 9 inches apart, leaving $1\frac{1}{2}$ inch resting at each end: weights were applied, by adding about 60 lbs. at a time, to a scale-pan suspended from a knife edge which bore on the middle of the prism.

Table LXIX.

Trials made in June, July and August, 1837, of the strength of concretes made in December 1836. The results show the weight in pounds required to break prisms of concrete 12 inches by 6 inches by 6 inches—the distance between the supports being 9 inches.

No.	Composition of the Concrete.	Mortar No. 1. Cement A. 1.00, Sand No. 1., Lime	Mortar No. 2. Cement A. 1.00, Sand No. 1. .50, Lime	Mortar No. 3. Cement A. 1.00, Sand No. 1. .50, Lime .25	Mortar No. 4 Cement A. 1.00, Sand No. 1. 1.00, Lime	Mortar No. 5. Cement A. 1.00, Sand No. 1. 1.00, Lime .25	Mortar No. 6. Cement A. 1.00, Sand No. 1. 1.50, Lime	Mortar No. 7. Cement A. 1.00, Sand No. 1. 1.50, Lime .25	Mortar No. 8. Cement A. 1.00, Sand No. 1. 2.00, Lime	Mortar No. 9. Cement A. 1.00, Sand No. 1. 2.00, Lime .25
1	Granite fragments, with 1 measure of mortar	4973	4142	2778	3989	2721	2045	2056	lost	1574
2	do. with 2 do.	4068	4983	5064	4088	5366	1547	3537	1643	1972
3	Brick fragments, with 1 measure of mortar	3242	2117		4127	3254	1788	2136	1567	3649
4	do. with 2 do.	2805	5047	2826	4232	1178	3655	3856	2320	4803
5	Stone gravel, with 1 measure of mortar	1097	1049	1240	1256	1066				
6	do. with 2 do.	2347	4247	2655	1295	3351				
7	Brick gravel, with 1 measure of mortar	5437	6183	3088	lost	4726				
8	do. with 2 do.	6025	5712	5480	3142	2699				
9	Stone fragments, grouted	3278	1846	2012	1158	1178				
10	Brick fragments, grouted,	1634	2305	2869	2726	2770				

Observations on the experiments given in the above table.

It is to be regretted that such discrepancies are to be noted in the table. They are ascribable, in the first place, as suggested above, to the difficulty of bringing the mixture always to the same condition as regards the dissemination of the ingredients, when worked in so dry a state; but, probably, chiefly to the difficulty of filling the moulds always with equal accuracy, and ramming every part with equal force, when using so incoherent a mortar, united with so large a proportion of very coarse ingredients.

Notwithstanding these discrepancies, however, several deductions may be fairly drawn from the table, which, if confirmed by future trials, will be useful.

1st. *When the mortar was made of cement, sand, and lime, or of cement and sand without lime, the concrete was the stronger as the sand was less in quantity.* In 50 comparisons 19 exceptions. *But there may be* 0.50 *of sand and* 0.25 *of lime without sensible deterioration; and as much as* 1.00 *of sand and* 0.25 *of lime, without great loss of strength.*

2d. *A mortar of cement and sand does not seem to be improved by the addition of lime, while the bulk of sand is only equal to, or is less than, the bulk of cement; but as the quantity of sand is further increased, the mortar appears to be more and more benefitted by the addition of a small quantity of lime.*

3d. *Two measures of mortar, in concrete, are better than one measure; that is to say, a quantity of mortar equal to the bulk of the void space does not give as strong a concrete as twice that quantity of mortar.* In 30 comparisons, 7 exceptions. Nevertheless, the strongest example was with one measure of mortar, and it is not unlikely that the deficiency of strength in the other cases resulted from the difficulty of causing all the voids to be accurately filled, when the mortar was a minimum, and the space into which it was forced so small. It is not improbable that the voids may be perfectly occupied, even with one measure of mortar, when the mass of concrete is large enough to permit the full effect of the rammer.

4th. The results of the experiments recommend the several compositions of the table, in the following order, namely:

1.	Brick gravel,	with 2 measures of mortar,		No. 8.
2.	do.	with 1	do.	7.
3.	Brick fragments,	with 2	do.	4.
4.	Granite fragments,	with 2	do.	2.
5.	do.	with 1	do.	1.
6.	Brick fragments,	with 1	do.	3.
7.	Stone gravel,	with 2	do.	6.
8.	Brick fragments, grouted			10.
9.	Stone fragments, grouted			9.
10.	Stone gravel,	with 1 measure of mortar		5.

5th. *It appears that the best material to mix with mortar to form concrete, is quite small, angular, fragments of bricks: and that the worst is small, rounded, stone-gravel.*

6th. *Grout, poured amongst stone, or brick fragments, gave concretes inferior to all, but one, of those obtained from mortars.*

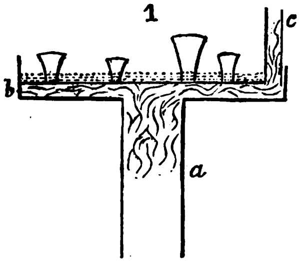
A piece of sound and strong *red sand-stone*, 12 inches by 4 inches by 4 inches, required a weight of 3673 pounds to break it—there being 9 inches between the supports. According to the formula $P=R.\frac{ab^2}{c}$,* prisms of

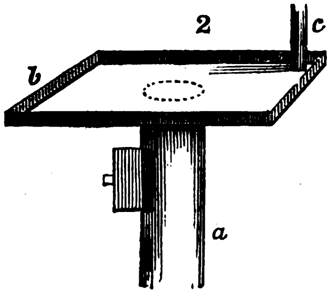
* In this formula P is the weight causing fracture, c the distance between the supports, a the breadth, and b the depth of the prisms.

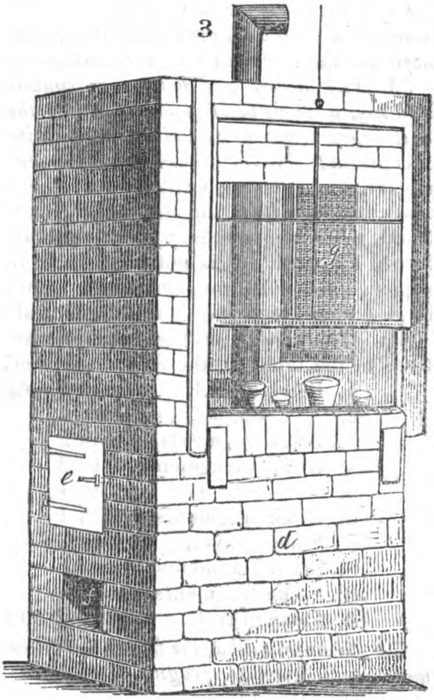
this stone, of the size of our prisms of concrete, would require the weight of 12,396 lbs. to break them; whence it appears that the strongest concrete under trial, was, after eight months exposure, half as strong as this sandstone.

Description of a convenient mode of arranging a sand bath.

The practical chemist is always more or less incommoded by the corrosion of the balances and other delicate pieces of apparatus in his laboratory, by the gases and vapours evolved during the processes upon his sand bath. He is moreover subject to uncomfortable heat in the apartment from the necessity of keeping his bath at an elevated temperature. To obviate these inconveniences, I have devised an arrangement the description of which may be useful to those pursuing the subject. The accompanying figures represent the construction of one which I have now in use.







a, figs, 1, 2, represents a nine inch sheet-iron stove, without its ordinary top, while *b* shows a rectangular sheet-iron bath, two feet long by 18 inches wide, made to fit as a top upon the stove; the heated air from the stove is then made to circulate under the sand bath, before it can pass out through the pipe. *c*, fig. 3, represents the stove and sand bath, in place, surrounded by brick-work. *d*, is a chamber in which the stove is placed, and corresponding in size to that of the sand bath. The fuel is introduced into the stove through the hole *e*, and the ashes removed through *f*. The

chamber is made to communicate with the external atmosphere, by holes in the outer wall, against which the arrangement is built. The effect of the body of air circulating around the stove is to prevent entirely the wall of the chamber from becoming heated. *g*, represents a window in the wall of the building occupied by wire gauze, through which the vapours pass out, while their escape into the apartment is prevented by the movable sash, seen in front. Thus at the same time that the operator has completely under his eye and control all his process, he is entirely exempt from the inconveniences of the common forms of sand baths. R. E. Rogers, M. D.

Civil Engineering.

Fifth Annual Report to the Building Committee of the Girard College for Orphans; by Thomas U. Walter, Architect.

Gentlemen:—I have the honour, in conformity with your resolution of the 26th inst., to communicate the following report on the progress of the work during the past year.

The marble work of the centre building is raised to the height of the third story floor; all the arches over the second story are completed, and the quoins are commenced for the vaulting to support the roof;—nearly all the marble required to complete the cell of the building has been wrought; —two of the large antæ capitals are finished, and the workmen are now engaged in executing the other two;—three of the columns on the eastern flank have been raised to their destined height, two more are ready to receive their capitals, and two others are more than half finished;—one of these columns has been fluted and entirely completed, and the fluting of another is nearly finished; several of the large architraves have been delivered; also about 7000 cubic feet of marble for bases, capitals, and columns, beyond what has been used, nearly all of which will be wrought during the winter.

The carpenters are now about commencing the centres for the third story arches, all of which will be ready to set as soon as the spring opens.

The easternmost out building, which embraces the dwellings of the Professors, is nearly completed, and the building nearest the College is in such a state of forwardness as to admit of its being finished (*if* required,) in three or four months;—I am, however, of opinion, that neither of these buildings should be entirely completed until the time shall have been agreed upon for occupying them, as new buildings deteriorate much faster without occupants than with them;—it would, therefore, be better to keep them in such a state of forwardness that possession may be given at a few weeks notice.

The whole quantity of marble that has been delivered during the past year, amounts to 37,648 cubic feet;—31,974 superficial feet have been wrought and used in the building, and there are now on the ground about 13,500 feet of finished work, 1828 feet that have been sawed principally for ashlar, and 5564 cubic feet in the rough.

There have been 873,150 bricks delivered at the work during the last season, which, together with the 500,000 left on hand from the previous year, make 1,373,150, of which 1,211,150 have been used in the building, leaving 162,000 bricks now on the ground.

All the contracts have been faithfully executed, and every part of the work reflects the highest credit upon the superintendents of the various mechanical branches;—an unusual degree of skill and industry has been

evinced by the workmen, and the most perfect harmony has prevailed in all the departments of the work.

The delivery of marble during the past year has fully equalled our expectations, and there remains no doubt that the contractors will be able to continue the supply as rapidly as it will be required.

The expenditures, from December 31st, 1836, to December 30th, 1837, amount to $181,839 79.

There is now on the ground about $85,000 worth of materials and workmanship which have not yet been used in the building, and which includes capitals, bases, column blocks, and architraves for the portico, the marble for finishing the cell of the main building, and the steps and yard walls of the out-buildings, all of which will be available for the work of next season.

The building is now in a situation to admit of more work being done during the ensuing season than has been accomplished in any one year since its commencement;—the marble work of the cell being nearly completed, there will be nothing whatever to interfere with the progress of the brick work; all the arches of the third story may therefore be constructed, and the building prepared for the roof, before the close of the season,—the columns and architraves of the flank porticoes, and the steps and yard walls of the out buildings, may also be readily finished during the next year, as the whole attention of the stone-cutters will be directed to these objects:—about $285,000 will be required to accomplish this amount of work; it therefore only remains for you to say whether the buildings shall be advanced thus rapidly or not.

A temporary roof has been constructed over the whole of the main building, and the greatest precaution has been taken to prevent injury from frost;—conductors have been made to lead the water from the top of all the arches into sinks in the cellar, for the purpose of preventing the rains that fall on the work during the summer from percolating through the abutments and arches, and saturating the work in the lower stories.

Temporary furnaces for drying and warming the building during the winter have also been constructed, and the warm air introduced into every room in the house, notwithstanding the unfinished state of the work;—this arrangement was deemed expedient, not only to prevent injury to the arches from congelation and consequent expansion by cold, but also for the purpose of evaporating as much dampness from the walls as possible, previous to the occupancy of the building.

The expansible properties of *iron* having been a subject of considerable conjecture in reference to the bands for resisting the lateral pressure of the arches, I was induced to make an experiment for the purpose of discovering the actual difference of temperature produced in the middle of the walls, by the extreme heat of summer and the severest cold of winter.

Although I have never had an idea that any evil could possibly result from the expansion of the iron in question, by an increase of temperature, the materials which surround it being subject to an expansion almost (if not quite,) equal to that of the iron, yet the satisfaction to be derived from positive evidence on the subject is sufficient to give interest to the experiment;—I shall therefore give a brief account of the manner in which it was conducted, so as to enable you to judge how far the result may be relied on.

The place selected for the experiment was the brick wall between the south vestibule and the large rooms;—the thickness of this wall is five feet five inches, and its distance from the south front of the cell twenty-six feet; the sun had therefore full power upon it during the summer, and in the

winter the whole building was covered with a temporary roof:—I should also remark, that the experiment was completed before any fires were made in the furnaces.

On the 23d of September, 1836, the temperature on the work being at 82° Fahrenheit, a self-registering *minimum* thermometer was placed upon the iron band in the middle of the wall, and the work constructed as solidly around it as the rest of the building.

On the 29th of July, 1837, the temperature being again at 82°, a hole was made in the wall, and the thermometer taken out, when it was found that the register had descended to 42° during the intermediate winter, the extreme cold of which was 3° below zero:—thus we find the greatest cold in the middle of the walls to be 42°.

On the 16th of January, 1837, the temperature on the building being 24° Fahrenheit, a self-registering *maximum* thermometer was placed on the iron band in the middle of the aforementioned wall, on the same horizontal line with the other thermometer, and about sixty feet distant from it, a space having been left in the wall when it was built, for the purpose; which space was walled up around the thermometer as firm and compact as the rest of the work.

On the 16th inst., the temperature on the building being again at 24°, the walling was taken out, when it was found that the register in the thermometer had gone up to 61° during the intermediate summer, the greatest heat of which was 94°.

We have therefore 42° for the lowest temperature of the iron bars, and 61° for the highest, making a difference of 19°.

The expansion that an increase of temperature of 180° produces upon malleable iron, is given by Dr. Ure, in his Dictionary of Chemistry,* as follows:

From experiments by Smeaton $\frac{1}{794}$ of its length; according to Borda's experiments $\frac{1}{865}$ of its length; and according to Dulong and Petit $\frac{1}{846}$ of its length.

Mr. Hassler, (of New Jersey,) in his "Account of Pyrometric Experiments," read before the American Philosophical Society, June 29th, 1817,† finds the expansion to be equal to $\frac{1}{798}$ of its length; and in a work on Natural Philosophy, by Biot,‡ we have the experiments of Lavoisier and Laplace, made in 1782, giving an expansion, under the same increase of temperature, equal to $\frac{1}{819}$ of its length.

The trifling difference in these results may be attributed to a difference in the density of the material.

Now, if 180° will increase a bar $\frac{1}{794}$ of its length, (this being the greatest expansion obtained by the foregoing experiments,) 19° will lengthen it only $\frac{1}{7526}$; hence the bands around the rooms of the College, (each being 54 feet long from the points of support,) will be subjected to a difference in their length between the extreme heat of summer and the severest cold of winter, of $\frac{1}{7526}$ or $\frac{1}{12}$ of an inch.

This being the actual difference produced in the length of the iron bands, by the greatest change of temperature to which they can be subjected, it remains for us to consider the expansibility of the materials with which they are surrounded.

A table on the expansion of different kinds of stone, &c., from an increase

* Ure's Dictionary of Chemistry, page 272.

† Transactions of the American Philosophical Society—new series—Vol. I., page 227.

‡ Physique de Biot, Vol. I.

of temperature, is given by Mr. Alexander J. Adie, civil engineer, in a paper read before the Royal Society of Edinburgh, on the 20th of April, 1835,* in which he makes the expansion produced upon bricks by 180° of Fahrenheit, equal to $\frac{1}{1818}$ of its length, or $\frac{1}{26}$ of an inch in 54 feet under an increase of temperature of 19°.

If, therefore, the maximum expansion of one of the iron bands in the walls of the College is $\frac{1}{13}$ of an inch, and the brick work surrounding it $\frac{1}{26}$, the difference is then reduced to nearly $\frac{1}{22}$ of an inch:—but if we consider that the variation of temperature in the interior of the wall is only 19°, while the exterior is subjected to the extremes of heat and cold, it will be obvious that the aggregate expansion and contraction of the brick work is even greater than that of the iron.

From these considerations, it is evident that not the slightest injury can possibly result from the use of iron in the construction of the College.

I am, gentlemen, very respectfully, your obedient servant,

Thomas U. Walter, Architect.

Girard College, December 30th, 1837.

To James Hutchinson, Esq.
Chairman of Building Committee, Girard College for Orphans.

Physical Science.

For the Journal of the Franklin Institute.

Report of some Meteorological Observations made at Frankford Arsenal, near Philadelphia. By Captain A. Mordecai, of the Ordnance Department.

1. *Of the Temperature.*

In a former paper on this subject [Journal of Franklin Institute, Vol. XIX. p. 7] I gave the results of hourly observations of the thermometer during one year, from which were deduced the hours of daily mean temperature, and of daily maxima and minima in each month, and it was also shown that the mean temperature derived from the daily extremes is the same as that derived from hourly observations. As the temperature changes very slowly near the maximum and minimum points, the observation of the extremes of daily temperature is little subject to error, and we have thus a method of testing the accuracy of the deductions previously made, as to the hours of observation for the mean temperature of the day. For this purpose I have made, during two years, four daily observations of the thermometer; two for the maxima and minima, and two for the means. The hours selected for the observations, and the results for each of the years ending 30th April, with the average for the two years, are presented in the following table.

*See Journal of the Franklin Institute of the State of Pennsylvania, Vol. XX. page 200.

Table of Mean Temperature.

	Hours of Observation.				1836, '37.			1837, '38.			Two Years.		
	For the Means		For the Extremes.		Mean temperature deduced from			Mean temperature deduced from			Mean temperature deduced from		
	A. M.	P M.	A. M.	P. M.	daily means.	daily extremes.	4 daily observations.	daily means.	daily extremes.	4 daily observations.	daily means.	daily extremes.	4 daily observations.
	H. M.	H. M.	H.	H. M.									
May,	8.30	7.45	4.	2.30	62.05	61.51	61.78	59.82	59.53	59.82	60.94	60.52	60.80
June,	8.	8.	4.	2.30	64.03	64.61	64.32	67.75	67.63	67.01	65.89	66.12	65.76
July,	8.	8.	4.	2.30	72.83	73.49	73.20	71.60	72.41	72.01	72.22	72.95	72.61
August,	8.	8.	4.	2.30	76.60	68.32	67.95	70.34	71.08	70.90	68.97	69.66	69.43
September,	8.30	7.30	5.	2.30	65.94	67.38	66.87	61.97	62.50	62.27	63.96	64.94	64.57
October,	9.	7.	6.	2.30	48.44	48.36	48.58	54.17	54.36	54.54	51.32	51.36	51.56
November,	9.	7.	6.	2.30	40.33	40.78	40.82	45.31	45.85	45.62	42.82	43.32	43.22
December,	9.	7.30	6.	2.30	32.35	32.47	32.62	35.45	35.30	35.39	33.90	33.89	34.00
January,	9.	7.30	6.	2.30	27.81	27.40	27.68	36.29	36.80	36.63	32.05	32.10	32.15
February,	9.	8.	6.	2.30	31.74	31.86	32.21	24.35	24.58	24.59	28.05	28.22	28.40
March,	9.	8.	5.	2.30	38.57	38.80	38.87	40.37	40.72	40.58	39.47	39.76	39.73
April,	9.	8.	5.	2.30	47.92	47.98	48.06	46.00	46.16	46.13	46.96	47.07	47.09
12 months.					49.97	50.24	50.25	51.11	51.41	51.29	50.54	50.83	50.77

This table shows the mean temperature deduced, 1st, from two daily observations at the hours stated in the first and second columns; 2nd, from two observations at the hours stated in the third and fourth columns; 3rd, from the four daily observations combined. These results, agreeing very nearly with each other, show that the hours chosen for the observations of the mean temperature are nearly correct; but in comparing the results of the morning observations for the mean with those of the evening, (results which it is not thought necessary to show separately in the table,) I find that the former give generally (and especially in the summer season,) too low an average, and the latter a little too high; the excess in the one case not compensating for the defect in the other; as the general average is seen to be somewhat too low, when compared with the general mean of the ex-

tremes. A closer approximation to the true times of mean daily temperature could hardly have been expected, from a register of only one year's observations, but by the aid of the above table we may correct the previous deductions, and we shall probably find the true times for observing the mean daily temperature to be nearly as follows, viz:

	h	h
For February, March, April, and May,	9. A. M.	8. P. M.
June, July, and August, . .	8.30	8.
September, October, November, Dec. and Jan.	9.00	7.30

I subjoin a statement of some general results of the three years observations.

	°
Mean temperature of the year ending April 30th, 1836	49.21
Maximum observed July 13th, 3 and 4 P. M. .	89.50
Minimum observed February 6th, 5 and 6 A. M. .	−7.00
Extreme range of temperature . . .	96.50
Mean temperature of year ending April 30th, 1837, .	50.24
Maximum observed July 9th, 2½ P. M. . .	89.00
Minimum observed January 3d, 6 A. M. . .	6.00
Extreme range of temperature . . .	83.00
Mean temperature of year ending April 30th, 1838. .	50.77
Maximum observed August 30th, 2½ P. M. .	89.00
Minimum observed February 21st, 6 A. M. . .	10.00
Extreme range of temperature . . .	79.00
Average of three years.	
Mean temperature, ...	50.07
" Maximum, ...	89.17
" Minimum, ...	3.00
" Yearly range, ...	86.17

2. *Of the Rain.*

At the same time with the thermometric register, I began a series of observations with a view to furnish data for discussing the question of the relative quantities of rain received on equal surfaces at different heights above the ground. For this purpose two stations were chosen; one on the ground, in an open garden; the other on the top of a tower attached to the principal store house at the Arsenal, and about 250 feet in a south-easterly direction from the first. The tower is about twenty five feet square; it has a flat roof surrounded by an open balustrade about three and a half feet high, and the roof is nearly on a level with the ridge of the building to which the tower belongs; the tower is on the west side of the building, the ridge of which runs north and south. The prevalent winds are N.E. and N.W. The roof of the tower is fifty-two feet above the ground at the first station, which latter is about twenty-three feet above low water in the Delaware. The surrounding country is open and nearly level for more than 100 miles towards the north and west, and on the south and east no high lands intercept the winds from the Atlantic. The same kind of rain gauge was used at each station: it consists of a cone of tin to the base of which is attached a short cylindrical rim 5 inches in diameter, the water received in which passes through an opening of $\frac{3}{16}$ of an inch at the apex of the cone, into a cylindrical receiver to the neck of which the conical part is closely fitted by a collar; the whole is painted white and enclosed in a wooden box likewise painted white.

The water thus collected is measured in a glass tube graduated so as to allow of reading less than $\frac{1}{1000}$ of an inch of rain. The measurements were

punctually made immediately after each rain, but the evaporations from these gauges is so slight that no appreciable error would have arisen from permitting the water to stand in them many days.

To test this experimentally the two gauges were placed side by side during the month of July, 1837; it rained eight times during the month, and half of the whole quantity of rain fell before the eighth day: one of the gauges, measured after each rain, gave a total of 3in.677; the other at the end of the month gave 3in.680.

To measure the snow, which would fill the conical part of the gauge without finding its way into the receiver, I used two other gauges of the same diameter as the first at the top, but widening downwards and terminating in a receiver of sufficient capacity to contain all the snow that could enter it during one storm. These gauges, whilst in place, were measured for the rain as well as the snow, and although the individual results did not always correspond, the total for each month generally confirmed that obtained from the rain gauges.

In consequence of the drifting of the snow it may be thought that the quantity received in an open vessel cannot afford an accurate measure of that which falls; but the general agreement in the results obtained from the two gauges at each station, in the frequent cases where the snow in both could be measured, leads me to think that the error from this cause is not great.

Under the head of temperature in the following table, are shown the mean temperature of each period, and the average daily range of temperature, or mean of the daily maxima and minima, derived from the observations referred to in the preceding part of this paper. The column of "ratios" shows the proportion of the quantity of rain received on the tower to that received on the ground, the latter quantity being represented by 1000. The height of the tower is not sufficient to admit of an intermediate place of observation between it and the ground, and there is no higher point attainable at the arsenal: having then but one station above the ground, these results do not, in themselves, afford the means of discussing the laws of diminution of rain at various heights, but they may be useful for that purpose in conjunction with other observations of a similar kind which may have been made at Philadelphia, or its vicinity. Some such were made by Prof. A. D. Bache, on the top of a shot tower, in Philadelphia—I proceed to state such remarks as are suggested by an examination of table I.

1. Additional evidence is afforded to the now established fact of a diminution in the quantity of rain at different heights above the ground. A remarkable deviation, however, from this law is seen in the results of the winter observations in 1835–'36, where in the months of November, December, January and February, the greatest quantity of rain was received at the *upper* station; that winter was very cold, (the thermometer marking at one time 7° below zero,) and there fell a great quantity of snow, the measurement of which is, as before observed, included in the general statement; but the anomaly cannot be attributed to the accidental *drifting* of the snow, since it is equally marked in cases where little or no snow fell, and besides it would be much more apt to drift into the lower gauge than the upper. In the two succeeding winters, which were milder, with less snow, this anomaly is not observed, the diminution in the second winter being greater in the cold months than in the warm.

TABLE No. I—*Results for three years.*

	1835–'36.			1836–'37.			1837–'38.			Average of three years.				
	Mean. Temperature.	Rain. Ground.	Rain. Tower.	Mean Temperature	Rain. Ground.	Rain. Tower.	Mean Temperature.	Rain. Ground.	Rain. Tower.	Temperature. Mean.	Temperature. Mean range.	Rain. Ground.	Rain. Tower.	Rain. Ratio to 1000.
		in.			in.			in.				in.	in.	
May,	59.18	2.196	2.050	61.83	1.929	1.695	59.82	4.351	4.001	60.28	19.35	2.825	2.582	914
June,	67.78	4.231	3.936	64.33	7.665	7.137	67.01	2.814	2.737	66.37	14.06	4.903	4.603	939
July,	71.58	6.159	5.861	73.20	1.917	1.835	72.01	3.677	3.356	72.26	14.03	3.918	3.684	930
August,	68.46	2.494	2.289	67.95	2.356	2.297	70.90	4.579	4.250	69.10	13.87	3.143	2.935	934
September,	59.43	2.900	2.723	66.87	1.906	1.814	62.27	2.228	2.126	62.86	14.10	2.344	2.221	948
October,	56.20	1.169	1.051	48.58	2.929	2.649	54.54	0.569	0.524	53.11	16.02	1.555	1.408	906
November,	44.98	2.862	2.906	40.82	2.921	2.792	45.62	2.386	2.248	43.81	13.06	2.723	2.648	972
December,	29.90	2.799	2.987	32.62	3.850	3.385	35.39	2.367	2.289	32.64	12.42	3.005	2.887	962
January,	27.68	5.138	5.407	27.68	1.745	1.598	36.63	1.721	1.600	30.66	11.96	2.867	2.869	1000
February,	23.07	2.498	2.662	32.21	2.809	2.651	24.59	1.549	1.468	26.62	12.85	2.289	2.260	987
March,	33.58	1.420	1.390	38.87	3.425	3.332	40.58	2.242	2.173	37.68	15.68	2.362	2.298	973
April,	48.65	3.019	2.943	48.06	1.969	1.850	46.13	2.841	2.739	47.61	16.16	2.610	2.510	962
Spring,	47.14	6.635	6.383	49.59	7.323	6.877	48.84	9.434	8.913	48.52	17.06	7.797	7.390	948
Summer,	69.40	12.884	12.086	68.49	11.938	11.239	69.97	11.070	10.343	69.24	13.99	11.964	11.222	938
Autumn,	53.54	6.931	6.680	52.09	7.756	7.255	54.14	5.183	4.898	53.26	14.39	6.622	6.277	948
Winter,	26.88	10.435	11.056	30.84	8.404	7.634	32.20	5.637	5.357	29.97	12.41	8.161	8.016	982
6 warm months,	63.77	19.149	17.910	63.79	18.702	17.397	64.43	18.218	16.994	64.00	15.24	18.688	17.433	933
6 cold months,	34.64	17.736	18.295	36.71	16.719	15.608	38.16	13.106	12.517	36.50	13.69	15.856	15.472	976
12 months,	49.21	36.885	36.205	30.25	35.421	33.005	51.30	31.324	29.511	50.25	14.46	34.544	32.905	953

The only notice which I have seen of such an excess of rain at the upper station is in the Journal of the Franklin Institute, vol. XVII, p. 286, where it is recorded that at Kinfaun's Castle, a greater quantity of rain

was received, in 1834, in a gauge elevated 160 feet above the ground, than in one on the ground; the difference in this case was very small, (only $\frac{15}{100}$ of an inch,) but the observation is not the less remarkable, for at such an elevation a difference of at least one third in favor of the lower gauge might be expected.

2. The average quantity of rain received on the ground is 32½ inches in a year; the average quantity fallen in the six warm months has been greater than in the six cold months. The quantities fallen in Spring and Autumn, have been nearly equal, but the average in summer has exceeded that in Winter by nearly *one fourth.* Here it should be remarked, however, that this great disproportion is occasioned chiefly by the unusually great quantity of rain, (nearly nine inches,) which fell between the 28th of May and the 30th of June, 1836.

3. The average diminution of quantity at the height of 52 feet is about 5 per cent; and this result of the three years observations agrees very nearly with that which is obtained from an average of the rain that has fallen without wind or with very light winds, when the observations may be considered least liable to error.

4. The diminution at the upper station is, in the three years, and in the general average, greater in Summer than in Winter. This result also is inconsistent with those of previous observations. In the reports of the British Association for the advancement of Science, (third and fifth meetings,) the present subject is discussed mathematically by Prof. Philips, from the results of three years observations at York, from which he has deduced formulæ to represent the relation which the diminution of rain bears to the height of the station and to the temperature of the season; but as his observations gave the diminution greatest in the cold season, he makes the *amount* of diminution dependant on the temperature of the season *inversely*, whilst here it appears to vary with the temperature *directly.*

5. The column of mean daily range of temperature in the table, is given as a substitute for the observation of the mean dew point in ascertaining the relative dryness of the air at different seasons; the dryness being considered directly proportional to the mean range of temperature. Here again, if my observations are correct, the law of diminution is different from that which obtains at York; for the diminution of rain as we ascend seems here to be greatest in the dryest season, or when the mean range of temperature is greatest; whereas at York it bears an *inverse* relation to the mean range. The latter relation seems the more probable, and accords with the natural solution of the question, which attributes the increase of the quantity of rain in descending to an augmentation of the drops in passing through a warm and more moist tract of air: I am, therefore, inclined to doubt whether some disturbing cause, that may impair the correctness of the observations, may not have escaped my notice. But the laws of variation in the quantity of rain may be, and probably are, very different in our climate from those which hold good in England, and my observations having been carefully made, will serve, I hope, to throw some light on the subject.

In order to ascertain whether such a disturbing cause as I have referred to could be found in the direction of the wind, at the time of the rain, I have arranged the results of the observations with reference to the course of the wind as in the following table.

TABLE II—*Average quantity of rain from each quarter.*

1835 to 1838.	RAIN.									
	N. E.		S. E.		S. W.		N. W.		TOTAL.	
	Ground.	Tower.	Ground.	Tower.	Ground.	Tower.	Ground.	Tower.	Ground.	Tower.
May,	2.153	1.978	0.153	0.146	0.400	0.372	0.116	0.086	2 825	2.582
June,	2.315	2.153	0.916	0.914	1.222	1.162	0.447	0.384	4.903	4.603
July,	2.931	2.766	0.166	0.162	0.572	0.521	0.248	0.235	3.918	3.684
August,	1.492	1.423	0.219	0.196	0.628	0.596	0.804	0.720	3.143	2.935
September,	1.515	1.444	0.515	0.487	0.273	0.251	0.041	0 039	2.344	2.221
October,	0.749	0.678	0.211	0.197	0.534	0.479	0.061	0.054	1.555	1.408
November,	1.670	1.695	0.286	0.237	0.571	0.529	0.196	0.187	2.723	2.648
December,	0.940	0.913	0.658	0.612	0.631	0.521	0·776	0.841	3.005	2.887
January,	2.290	2.318	0.	0.	0.348	0.322	0.229	0.229	2.867	2.869
February,	1 916	1.928	0.134	0.111	0.235	0.219	0.004	0.002	2.289	2.260
March,	1.955	1.910	0.253	0.250	0.154	0.138	0.	0.	2.362	2.298
April,	1.507	1.451	0.	0.	0.757	0.729	0.346	0.330	2.610	2.510
Six warm months,	11.158	10.442	2.180	2.099	2.626	3.381	1.717	1.518	18.688	17.433
Ratios,	1000	936	1000	961	1000	932	1000	884	1000	933
Six cold months,	10.278	10.215	1.331	1·210	2 696	2.458	1.551	1.589	15.856	15.472
Ratios,	1000	994	1000	909	1000	912	1000	1.024	1000	976
Twelve months,	21.436	20.657	3.511	3.312	.6325	5.839	3.298	3.107	34.544	32.905
Ratios	1000	963	1000	943	1000	923	1009	942	1000	953

From this table it would appear that the ratio of the quantities of rain at different heights is not much influenced by the mere *direction* of the wind, for the ratios of the quantities received from the same direction in different seasons do not correspond. The relative ratios in different seasons, from different directions appear anomalous, but it is to be remarked that the quantity of rain received at one time from other than the N. E. direction is, generally speaking, so small that the error of measurement, or of accidental variation, is more sensible.

In comparing the individual observations, I observe that the *force* of the wind exercises a decided influence on the ratio of the quantities of rain;

the diminution in the upper gauge being generally greater in proportion to the violence of the wind; in one instance, of a violent storm from the S. W. the diminution was as great as 36 per cent. This effect must be attributed chiefly to eddies from the roof of the building, preventing the rain from entering the gauge, and from this cause it is probable that we shall arrive at a correct mathematical solution of our question only by taking account of the rain which falls in calm weather, or accompanied by very light winds. At the same time I must remark that in analysing the second and third years' observations, omitting those in which the rain was accompanied with high winds, I do not find that the results differ materially from those given by the general average for those years.

Table II is interesting as exhibiting the average quantity of rain which has reached us in each of the last three years, from different quarters. Thus we see that *two thirds* of the whole quantity has come from the N. E., about *one-sixth* from the S. W., and *one-twelfth* from each of the other quarters. The numbers in the table are the results of 260 observations, being for each of the three years an average of 87, viz:

From N. E. . .	43	observations,
S. E. .	7	"
S. W. . .	24	
N. W. .	13	"
Mean total	87	"

The average number of days in each year on which rain or snow fell is 117.

Mechanics' Register.

LIST OF AMERICAN PATENTS WHICH ISSUED IN SEPTEMBER, 1837.
With Remarks and Exemplifications by the Editor.

267. For an improvement in the mode of *Working Pumps for Pumping Ships, &c.;* David Gay, Bath, Lincoln county, Maine, September 8.

The pumping is to be effected by the rolling of the vessel, and to effect this there is to be a vertical shaft of iron, having a step, and a bearing in a suitable frame. Towards the upper end of this shaft there is to be a cast iron weight, sustained by means of arms, which weight is to cause the shaft to revolve. Near the lower part of the shaft is a horizontal wheel, firmly attached, and sustaining seven, or any other suitable number of, friction wheels, which may be one foot each in diameter; they are to revolve on centre pins passing through the face of the horizontal wheel, near its periphery, and, of course, projecting nearly one half their diameters beyond said wheel. As the shaft revolves, or vibrates, these friction wheels are to work three pump brakes, with projecting arms from which they are to be kept in contact, by means described in the specification. As the vessel will not be always rolling, a hand lever is attached to the apparatus, to work the pumps when necessary. The claim is to "the application of the weight to the shaft of the eccentric wheel for giving motion and action to the pistons of the pump, by the rolling or pitching of the ship, or vessel, at sea, or in rough water; and combining therewith a hand lever for working the pump by hand when the ship has not sufficient motion."

There have been various devices, patented and unpatented, for working

pumps either by the rolling, or the way, of a vessel, possessing, of course, various degrees of merit. We do not think, however, that the one before us, although denominated an improvement, will justify the name; it must itself, we apprehend, be greatly improved, before it will perform its office well, or do more than occasionally deliver a few quarts of water.

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268. For an improvement in the mode of constructing the *Hubs of Carriage and Waggon Wheels for containing Oil;* Abraham Randall, Vernon, Oneida county, New York, September 8.

These hubs are to be of cast iron; and it is proposed to cast them in three pieces, which are to be united together by means described in the specification. The main feature of novelty is the casting the parts hollow, so as to form large reservoirs for oil, which is to be poured in through openings closed by screws. Through the centre tube or box, which receives the axle, there are to be holes, communicating with these reservoirs, so as to keep up a continued lubrication. The claim is to "the casting of hubs with hollow compartments for containing the oil or other lubricating matter, having holes communicating with the axle; the compartments covered by screw boxes, substantially as above described."

Reservoirs for oil, in the hubs of wheels, are well known applications; the novelty, therefore, of the foregoing plan exists only in the particular way in which these are arranged and constructed, as making a part of a cast iron hub.

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*For a machine for *separating Smut from Wheat;* Benjamin M. Smith, Rochester, Monroe county, New York; Patent dated August 1.

The claim to this machine is as follows:

"What I claim as my invention is the constructing of a machine for cleaning wheat or other grain, having a shaft with revolving disks, the upper surfaces of which are made rough by punching, or otherwise; which disks are surrounded by a case, the interior of which is also made rough by punching; and by the insertion of metallic points in alternate sections; the whole being constructed, and operating, substantially in the manner set forth. I also claim the vanes, as combined in this machine, and the particular manner of forming the step." The grain is to be let in at the upper end of the machine, whence it falls through a hole upon the upper revolving plate, where there are arms, or vanes, which throw it forcibly against the shell, or case. These vanes are to create a wind, by which the process of cleaning is to be aided. There also are to be similar vanes on the lower disk, which are to operate in a similar manner. One half of the outer case, in segments, is to be of sheet iron, punched, like a grater, from the outer to the inner sides, leaving numerous openings through which the smut, and other dust, may escape. The particular manner of forming the step consists in the surrounding it with an oil cup, within which oil is constantly kept, and upon which there is a cover to keep out dust. Analogous contrivances have been used, but probably not such as could be deemed identical.

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269. For a machine for *Moulding and pressing Bricks;* Nathaniel Adams, Cornwall, Orange county, New York, September 8.

A cylindrical box is placed vertically, to contain the clay to be moulded. The bottom of this box consists of bars of metal at suitable distances for the clay to pass through to the moulds beneath, which are slid in under the bars, an empty set of moulds being made to push a full set out.

*The numbering of this patent is omitted, it having been noticed in the last list, by mistake. The present notice, however, is more full.

Within the cylindrical box, a vertical shaft is made to revolve by any suitable power, and upon this is placed what is called a circular inclined plane which consists of a plate of metal fastened to the shaft, and extending out so as nearly to touch the box; this plate forms a single thread of a screw, and by its revolution causes the clay to descend. An intermitting motion is given to the shaft, to prevent the descent of the clay during the time of changing the moulds; the contrivance for effecting this we cannot now describe, but it manifests ingenuity. The claim is to "the combination of the parts of said machine in the manner above described, or in any other manner substantially the same, for the purpose aforesaid; but no part separately, or independently of this combination."

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270. For an improvement in the construction of *Door Locks;* Turner Whitehouse, Boston, Massachusetts, September 8.

The whole of the proposed improvement consists in the employment of a number of friction rollers within the lock, for the purpose of making it work easily. There are two, for example upon the lock bolt, for the key to operate against; one larger one upon the dog, or tumbler, to receive the lift of the key; another upon the dog, or tumbler, for the spring to play against, which forces it down. The tumbler of the latch bolt, also, plays against friction wheels, there being three devoted to this object. The claim is to "the application of the several friction wheels, and the adaptation of the various parts of the lock for the reception of these friction wheels, as represented in the drawings."

One thing must be perfectly plain, namely, that by this application of friction wheels a lock is rendered much more complex than without them, whilst the main purpose of a lock, security, is not in any degree promoted; its liability to become foul, and to get out of order, will also be increased. The gain we think very trifling, as in a well made lock, the amount of friction is very small, so small that it is scarcely desirable to lessen it.

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271. For a *Non-radiating hot air Stove;* Benjamin Blaney, Boston, Massachusetts, September 8.

There is too much complexity in this stove for verbal description. In the drawing of it there are six different figures explanatory of its various arrangements. The claims are to "the application of the cold air to the inner surface of the outer case, over the whole space from the base to the top of the stove, by the mode in which it is admitted through the air box into the cold air chamber, and caused to circulate between the outside case and the loose case, and between the loose case and the perforated case, before it passes through the perforated case into the hot air chamber, to act upon the heated cylinder. Also the application of the loose case to the hot air stove for the purpose of preventing the direct rays from the heated cylinder acting through the perforations upon the outside case, in the manner described."

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272. For improvements in *Window Sash Springs* for upper sashes; Henry Hammond, Lewisburg, York county, Pennsylvania, September 8.

This improvement consists merely in so forming a spring for sashes, as that it may be applied to the upper as well as to the lower sash; the kind of spring alluded to is that which catches into notches, and holds the sash at various heights, having a thumb piece by which it is pressed back. The

claim made is to "the particular form and manner of applying the spring for the upper sash, as described."

273. For an improvement in the construction of *Stoves;* George F. Hopkins, city of New York; Patent dated March 8.

This stove is made of cast iron, is open in front, and has a grate for coals which may be removed, for the purpose of burning wood. The sides of the stove are vertical, and are segments of a cylinder. There are two doors which are also segments of cylinders; which doors when drawn together close the front, and when opened, slide in grooves and run back so as to cover the side plates, with the curve of which they correspond. The back plate of the exterior of the stove is flat, and two or three shelves project out from it, for the purpose of sustaining articles which it is desired to keep warm. At the back of the fire place there is a cast iron plate, reaching from the top to the bottom of the stove. This also is a segment of a cylinder, standing with its convex sides towards the fire. Between the two back plates there is a space of about four inches, constituting a chamber, or reservoir, of heated air. The claims are to;

"1st. The employment of sliding doors, running in curved grooves formed in the upper and lower plates, to receive them, as set forth.

"2nd. The placing of metallic shelves against the rear plate of the stove, in the manner and for the purpose specified.

"3rd. The form and construction of the chamber essentially in the manner and for the purpose specified."

This stove is described with special care and minuteness, and the virtues of its construction and arrangement, dwelt on with much complacency, and that in several instances in which our perceptions have been too obtuse to enable us to discover the difference between the parts described and analagous parts in numerous other stoves. Judging from the drawing the stove has a neat appearance, and with the same supply of fuel which furnishes a given portion of heat in some other stoves, we have no doubt that this would behave equally well.

274. For an improvement in the *Steering Apparatus for Ships, &c.* called Nicholson's steering wheel and guide; Samuel Nicholson, city of Boston, September 12.

The tiller is to be fixed in the rudder head, so as to stand a little above the deck, and upon the deck there is to be laid a frame, or platform, having a curved edge, adapted to the sweep of the end of the tiller. The curved edge of this frame is grooved so as to receive a tiller rope; this part of the apparatus is called the guide. Near the end of, and upon the tiller, there are to be raised two vertical posts, one behind the other, to support a common upright steering wheel,and the wheels by means of which it is to operate upon the guide. The steering wheel is fixed upon a shaft which has its bearings in the two posts; which shaft projects out through the hind post to receive the wheel. Upon this same shaft, between the posts is fixed a toothed driving wheel of six inches diameter, which mashes into a wheel below it of eighteen inches diameter, the shaft of which is also sustained by bearings in the two posts. Upon the shaft of this last wheel there is a drum, or whirl, of the same diameter with the wheel, grooved, and sufficiently thick, to receive the turns of the tiller rope, which is to be wound round it. On the under side of the tiller, small grooved pulleys, or sheeves, are so ar-

ranged as to conduct the tiller rope directly upon the grooves of the guide. The outer ends of this rope are attached to the hind part, or back of the guide, which is a semicircle, or nearly so. This constitutes the general arrangement of the apparatus, and it will be seen that by turning the steering wheel the tiller may be carried round. The patentee points out various modifications of his apparatus, and then says, "What I claim as my invention is the fixed and permanent guide, distinctly, and by itself; and then the combination of the guide with the cog wheels and cylinder, forming the machine above described.

"The advantage gained by the guide is the prevention of slack in the steering rope, so that where the tiller traverses the deck, the deck is kept unincumbered for the passage of men, spars, &c.; and at all times the movement of the steering wheel is immediately felt by the helm."

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275. For improvements in the *Machine for Pressing Bricks*; Andrew F. Mervine, St. Louis, Missouri, September 12.

The particular mode of arranging and guiding the levers in this press would require either an engraving or a very long description, to make them known; not because the machine is itself specially complex; but because an actual form which may be perceived and understood by a glance of the eye, may not be communicable in words, or may require too much circumlocution. The claims made are to certain peculiarities of arrangement.

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276. For *Machinery for making Bodies of Hats of Fur;* Henry A. Wells, J. James, and R. H. Peck, city of Brooklyn, New York, September 20.

This invention consists in the application of steam, issuing through openings in suitable tubes, upon a web of fur, which is wound upon cones by an improved apparatus, in which the transverse, vibrating, and rotary motions are so managed as to cause the various required operations to be simultaneously performed; the whole being "connected with the other operations provided for by said machinery, to form and harden a hat body, and prepare the same for the sizing operation, in a manner much easier, better, more expeditious, and cheaper, than has heretofore been done in any other way."

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277. For a *Stove, for Heating and Cooking;* Philip Wilcox, Springfield, Hampdon county, Massachusetts, September 12.

The claims are to certain things in which this stove is considered to differ from others, but they are not of a character to be made known verbally. The attempt to do this would generally produce more fatigue than edification. When patentees choose to furnish cuts, corresponding with their specifications, and exhibiting what they deem the characteristics of their inventions, we will insert them; in other cases we shall be compelled, most commonly, to "read them by their titles."

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278. For an improved *Planing Machine;* Alonzo G. Hull, Brooklyn, Kings county, New York, September 20.

In this machine the planing is to be effected by cutters placed upon the faces of wheels, or disks, which revolve vertically, as is the case with many other planing machines, and which, therefore, is not claimed. The pa-

tentee conceives, however, that his manner of combining the respective parts is substantially new, and makes claim to this particular combination. The planing is not to be effected by cutters upon a single wheel or disk, but on two or more in succession; against which the stuff is fed by means of an endless chain. The first of these wheels reduces the stuff in the manner of a jack plane, and it is subsequently smoothed by the others. The using of two or more such wheels, operating successively is claimed. The cutters on the reducing wheel are peculiar in their construction, there being four, or any other convenient number of, cutters set in one stock, so as to cut successively to different depths, in advance of each other; there is also a single cutter described and claimed, which has offsets causing it to operate in a manner analogous to those above noticed. Upon the smoothing wheel there are long cutters, or knives, extending from near the centre to its periphery, in a direction making an angle with the radii of the wheel. There are also shorter cutters arranged near the periphery, and face plates, to determine the thickness of the shaving; these are also claimed.

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279. For a machine for *Breaking and Cleaning Hemp and Flax*; D. M. Langley, and S. Davis, Westbrooke, Cumberland county, Maine, September 21.

In this machine there is a cylinder, the periphery of which is formed of slats passing from head to head, and resembling in form the slats on the bed of the ordinary break. This cylinder is placed in a frame so that it may revolve vertically, a small portion of its periphery projecting above the cheeks of the frame within which it revolves. There are two endless feeding aprons, one on each side of the cylinder, their upper surfaces being even with the top of the frame; upon these the flax or hemp to be broken is placed, and it is fed to the breaking cylinder by the revolving of these feeding aprons. A beater having three or more blades upon it, adopted to the spaces between the slats of the cylinder is hung by its outer end in a frame which stands at right angles to the main frame; and the outer end of this being acted upon by revolving cams, or lifters, causes the beater to rise, and allows it to fall by its gravity. By suitable gearing the cylinder of slats is carried round by an intermitting motion, as also are the rollers which carry the endless aprons; two blows are given by the beater between each movement of the cylinder. There are two pressing rollers, one over each of the inner rollers of the endless, or feed aprons, and between these and the aprons, the hemp or flax lies, they serving by their weight to hold it down as it is fed. The claim is to "the combination of the revolving cylinder breaker, with the beating breaker, and the aprons, as above specified."

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280. For an improvement in the *Machine for cutting Veneers*; Joseph Skinner, Stockbridge, Berkshire county, Massachusetts, September 29.

The description of this machine is of great length, and has reference to numerous figures in the drawings, of which we cannot attempt to give a general epitome. The veneers are to be cut by a knife made to traverse backward and forward, and the stuff to be cut is pressed by a roller along the point, or line, on which the knife operates, so as to prevent the cracking of the wood in advance of the knife. By this mode of cutting there is not any stuff lost, and the veneer is so thin that it may be rolled out of the way, as the cutting proceeds. The inventor says, "now what I claim as

my invention, is the use of a slide, or roller, in conjunction with a knife, or cutting tool, substantially as above described, for cutting veneers, or thin pieces of wood, for all useful purposes: the object of said slide, or roller, being so to compress the wood during the operation of cutting, as near as possible to the point of impact of the edge of the knife, or cutting tool, as to prevent the wood from parting, or separating in the grain, in advance of the knife."

"A knife and compressing slide, or roller, for cutting upon the above described principle, may be greatly varied with respect to both form and movements. The mechanical arrangements necessary for making the fundamental principle available, may be greatly varied, so as to cut either endwise, obliquely, or from a round log. Hard timber may be softened by steam, or otherwise heating, to facilitate the cutting the veneers, and to render them more pliant and yielding."

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281. For an improved *Pantaloon Measure*; Edwin Grimston, Danvers, Essex county, Massachusetts, September 21.

It will appear from the claim made that this instrument is constructed upon philosophical principles; the claim is in the following words:

"What I claim as new in this instrument in the measuring for Pantaloons, is the particular construction and arrangement of the respective slides, with their appendages, working upon a perpendicular bar, in the manner described; with the application thereof, to the ascertaining of the curves of the leg and body, by measuring their deviation, precisely, from a perpendicular, or other fixed line."

A vertical rod, four feet long, is to rise from one side of a horizontal platform placed upon the floor; upon this vertical rod there are four slides which may be slid up and down upon it, and be tightened by screws at different heights. These slides carry others which pass through mortises in them, and slide horizontally; the whole being graduated into inches and parts of inches. The person to be measured stands upon the platform so that the outside of the calf of the leg and also the hip, or body, just touch the vertical rod. The first slide is then placed opposite the hollowest part of the waist, and its horizontal slide pushed through so as to touch the body. The second slide is then so placed as to bring its curved bar between the legs, close up to the crotch; the third slide opposite, to the most concave part of the outside of the knee, and its shaft pushed through so as to touch the leg at this point. The fourth slide is to stand at that point of the ancle where the pantaloons are to terminate. The distance from the first to the fourth slides gives the whole length of the pantaloons, and the other slides give the variation of the respective parts from the perpendicular, and consequently the curvature to be observed in cutting, with the other information necessary to this process.

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282. For an improvement in the mode of *Supporting the Bodies of eight wheeled Rail Road Cars, and Carriages;* Richard Imlay, city of Philadelphia, Pennsylvania, September 21.

"The nature of my invention consists in placing two cylindrical plates one above the other, in the middle of the carriage, at each end of the car, so that the under one being confined to the body of the carriage, the springs to the upper one, and they connected to the body of the car, there-

by allows of any movement in turning curves, and also a complete rotary motion if desired."

The device above referred to consists of two cast iron wheels, like fifth wheels of a carriage; one of them, which may be two feet in diameter, is fixed firmly on to the centre of the transverse rail of the carriage. It has a stout rim rising vertically at its periphery, the whole being turned perfectly true. A second wheel, also of cast iron, fits into this, and has a bearing upon the lower one, of about four inches in diameter, near the centre. A flanch upon this second wheel covers the rim of the first but does not quite touch it, this being prevented by the centre bearing. The carriage is to rest upon the upper side of the second wheel. To this upper side are also attached three bars of spring steel, parallel to, and at a small distance from each other; these are to be of such length as to be received in pockets, or have their bearings otherwise, upon the side rails of the cars, by which means they become the springs upon which the carriage rests. The claim is to "the vibrating cylinder plates as set forth in the specification, whereby to support all kinds of eight wheeled rail road carriage bodies upon springs."

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283. For an improvement in the *Machine for making Wrought Nails;* N. W. Bishop, and Simon Brooks, Saybrook, Middlesex county, Connecticut, September 21.

The nails are to be fed in between vibrating dies sustained on two horizontal shafts one above the other, toothed gearing causing the shafts to vibrate in unison. One half the die of the upper shaft is capable of a lateral motion, and recedes from the other half, to allow the feeding, but when vibrating back again it is closed and presses the nail laterally, whilst the die on the lower shaft forms it longitudinally. There are also heading dies worked by a toggle joint, and the necessary apparatus for cutting the iron to the proper length. It will be seen that the general principle upon which this and some other wrought nail machines, operate, is the same; the peculiar arrangement only can be claimed.

"We do not claim the making of wrought nails by means of vibrating dies, nor do we claim the use of toggle joints for the opening and closing of dies generally, they having been before used. But what we do claim is the particular arrangement of the toggle joints as herein described, for the opening and closing of the dies, and also for the heading of the nails; this manner of using being, as we verily believe, new, and of our invention."

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284. For an improved method of *Preserving Timber and other vegetable products;* granted to John Knowles, and Robert Gilbert, executors of the estate of Robert Bill, of Great Britain. Auguste Gotthilff, of New York, their Attorney, September 21.

The claim will afford an adequate idea of the nature of this invention, viz:

"What is claimed as new, and as constituting the invention of the before named Robert Bill, is the saturating timber of all kinds with mineral tar or pitch, by covering the same therewith in suitable troughs or tanks, in which it is subjected to the action of heat, in the manner described; which saturation is for the purpose of preserving it from destruction by worms, from dry rot, or from decay from other causes. And also the saturating of

the fibres of hemp and other vegetable substances of which ropes are manufactured, with mineral pitch or tar, as obtained from mineral coal, either alone or in combination with the spirit of coal tar; and in the case of the material for ropes, in combination with turpentine, as herein described, applying the same in all cases at a temperature, and substantially in the manner, set forth, and including under the general denomination of mineral pitch, that species known by the name of asphaltum, or jew's pitch."

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285. For an improvement in the mode of making a *Batting, or Web for Hat Bodies;* Henry A. Wells, James James and Robert W. Peck, city of Brooklyn, New York, September 22.

This patent is taken for improvements on a machine invented and patented by Thomas Blanchard on the 14th of June 1837, and noticed at p. 176 of the last volume. The variations specified are ten in numbers, and the claims are to "the several additions to said machine, as specified, in their combination and connexion therewith."

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286. For an improvement in the composition of matter for *Fire Bricks;* Christopher W. Fenton, Bennington, Vermont, September 22. (See Specification.)

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287. For an improvement in the mode of *Regulating the temperature of Inking Rollers, &c.;* E. W. Arnold, Boston, Massachusetts, September 21.

A hollow metallic drum is to be made of the usual size of inking drums; which drum is to receive the ink from a common distributing roller, like those now used, which take it from the ink fountain underneath; inking rollers of the ordinary construction are to take the ink from this roller and distribute it on the form. One of the gudgeons of the metallic drum is to be hollow, and by means of this opening a pipe is to be introduced through which water may flow into the interior of the drum. This pipe is connected with a reservoir, which may be elevated about a foot above the level of the drum, and is to contain water either warm or cold, according to the temperature desired to be given to the drum. A waste pipe furnished with a stop cock, is also attached, by means of which the water may be drawn off. The claim is to "the heating and cooling, and regulating the temperature of inking rollers and ink, in the operation and process of printing, by the means aforesaid."

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288. For an improvement in the *Endless Chain Horse Power;* Jacob G. Hall, Zanesville, Ohio, September 21.

The improvement claimed consists in the form given to the links by which the slats, forming the revolving floor, are connected together; oval and semi-oval links being employed alternately, the latter embracing the slats of the floor. A claim is likewise made to the manner of constructing the endless chain of rollers, by passing the axles, or round rods on which they revolve, through the rollers and links, without riveting, or other fastening, and retaining them in their places by means of boxes, or troughs, the sides of which prevent their falling out.

289. For an improvement in the *Endless Chain Horse Power;* Aaron Palmer, Akron, Erie county, New York, September 22.

The links which join the slats are made in a peculiar form, having hinge joints, and straps which lap in such a way as to afford considerable sustaining power to the slats. The knuckle of the joint comes under the centre of each slat, a strap extending from joint to joint. In the drawing no other support is represented as being given to the floor upon which the horse is to walk. This will not answer in practice, the whole sustaining power being the joint pins, or the straps.

290. For an improvement in the *Slide Valves of Steam Engines;* for which a patent was granted to him on the tenth of July 1834; John Kirkpatrick, city of Baltimore, September 22.

This patent is taken for an improvement in the manner of carrying out the original plan of the patentee, by which the valves are intended to work with but little friction.

291. For an improvement in the mode of *Causing Puppet Valves to work light;* John Kirkpatrick, city of Baltimore, September 25.

The object in view in this improvement is to "cause the unequal action of springs to counteract the unequal action of the puppet valves in opening and shutting. As the valves push much harder when nearly shut, the spring being forced down by the valves in shutting, offer the greatest resistance at that time, and in rising they cease to act as the valves cease to require that action." The claim is to "the application of springs as described, either with or without the piston, to cause puppet valves to work light, using for that purpose any kind of springs best suited to the particular arrangement of the engine to which it is applied."

292. For improvements in the *Apparatus for Generating Steam in Cooking;* John Bouis, city of Baltimore, September 21.

In the specification of this patent, a long description is given of the mode of conveying steam from a boiler, to perform culinary operations, to heat baths, and for other purposes; but not presenting any thing that is new. The only thing claimed is "the form and construction of the boiler;" which is to be made of boiler iron, "in the form of the false back of a fire place."

293. For an improvement in the *Galley and Cooking Stove for Vessels, and Domestic uses;* Benjamin Spratley, Portsmouth, Norfolk county, Virginia, September 25.

Like stoves in general, especially those of a complicated character, the claims would not afford any insight into the particular arrangement upon which the claim to novelty is founded.

294. For an improvement in the *Hydraulic Current Wheel;* Warren P. Wing, Greenwich, Hampshire county, Massachusetts, September 22. (See Specification.)

295. For an improvement in the *Horizontal Water Wheel;* Chapman Warner, Oxford, Warren county, New Jersey, September 22.

A cistern, in the form of a vertical cylinder, is placed so as to stand on

the sheeting prepared for it at the lower part of a fall of water. This cistern has a hole in its centre through which the water is to escape, after it has acted upon the water wheel, the bottom of the cistern, or cylindrical reservoir, being sufficiently elevated above the sheeting, by means of blocks, for the water to pass out readily. A vertical shaft runs on a step upon the sheeting, in the centre of the opening above mentioned. From this shaft extend out six buckets, or vanes, upon which the water is to operate. These are surrounded by a rim having six openings through which the water is to pass to act upon the vanes, these openings are formed by curved pieces constituting the rim, arranged in the manner of the buckets in Wing's and other reaction wheels. There is a close cover fitted on to these rims, and securely bolted down. From the centre of this cover a tube is elevated through which the shaft of the water wheel passes, the tube rising sufficiently high to prevent the head of water admitted into the cistern from flowing over.

The claim is to "the application of a close chamber, or cistern, in combination with the before described water wheel, in which the water is received and made to strike all the buckets simultaneously, before it passes out at the bottom."

Like the class of wheels, denominated reaction wheels, that just described, will be very wasteful of water; where this is of no importance it may, from its simplicity, be useful; but whether better than the reaction wheels, in any respect, experience must determine; we see no reason, however, why it should be so.

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299. For an improvement in the *Manufacture of Sugar*; John Penny, and William Toland, Parish of Ascension, Louisiana, September 25.

"The object in view is to obtain a complete command of the necessary degrees of temperature, both in heating and cooling the pans, kettles, boilers, or clarifiers employed; which is effected by means of dampers and air flues, the former shutting off the heat at pleasure, and the latter admitting a current of cold air to circulate round the vessels when the heat has been shut off, and it becomes desirable to produce a rapid cooling." After this preliminary remark the specification proceeds to describe the particular manner in which the boilers are set, and the furnace and flues so constructed that by the aid of sliding shutters, or dampers, the heat may be regulated under each individual vessel, or cold air may be admitted in a rapid current whenever its influence is desirable.

The claims made are to "the application of heat, from one furnace, to the evaporating kettles, the granulating pan, and the clarifiers, in the manner set forth; in combination with the means of managing that heat by the aid of dampers, and the introduction of cold air into the space surrounding the clarifiers and crystallizing pan; the whole operating on the principle, and applied to the purpose described.

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300. For an improvement in his Patent *Lamp;* Samuel Rust, city of New York, September 25.

The patentee has made several successive improvements in his lamp, which he has made the subjects of patents. The present claim is to the particular manner in which he inserts a roller for raising the wick into the stopple of his lamp; in a more recent patent, which will be hereafter noticed, another arrangement for raising the wick, still more simple in its character, has been described.

301. For an improvement in the *Mode of Supplying Air to Wood and Coal Stoves;* Frederick Fickhardt, Easton, Northampton county, Pennsylvania, September 25th; patent dated March 25.

The object of the arrangement made in this stove is to supply heated air to the combustible; which heat is to be abstracted from the products of combustion as they escape in the smoke flue. For this purpose different arrangements may be made according to the form of the stove; the following may serve as an example. A smoke flue may surround an oven in the ordinary way; the cold air may be admitted through an opening at the lower end of the back plate of the stove, leading into a flue between the bottom plate of the stove, and the bottom plate of the smoke flues. The cold air thus admitted arrives under the grate bars at the front of the stove, and feeds the fire. In passing from this, around and under the oven, the heated air warms that which is admitted through the back plate. The claim is to the air flue, in the connexions above given.

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302. For a *Parceling Machine;* Obed Kempton, New Bedford, Massachusetts, September 25.

The process of parceling is the spreading of tar upon canvass for the purposes of the rigger; the machine which is the subject of the present patent is for effecting this object in a more expeditious and economical manner than heretofore. The claim will show with sufficient clearness the general construction of the machine.

"What I claim is the making of parceling by passing the canvass, or cloth, over a cylinder, which revolves in a pan or trough containing heated tar, and winding the canvass upon a spindle, the cylinder having a scraper placed at any distance from its surface to scrape off the superfluous tar; and the box or trough being placed upon a furnace or stove, all as above described."

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303. For an improvement in *Many Chambered Fire Arms;* Curtis Parkhurst, Lawrenceville, Tioga county, Pennsylvania, September 25.

In this gun the chamber is a segment of a cylinder, instead of being a complete cylinder, as in Cochran's; the chambers are bored in at the periphery, towards the centre upon which the segment is to revolve; there being a slat, or mortise, to receive it, in the rear of the barrel; the other parts are so arranged as to adapt themselves to the construction of the chambered segment.

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304. For an improvement in the mode of *Setting Axletrees, and in the Machinery therefor*; Timothy Fessenden, Boston, Massachusetts, September 25.

The object in view is to set the axles of carriages so that each shall have the same inclination from a horizontal plane; and consequently, when wheels are dished, to cause them to be equally so.

The apparatus claimed is a species of gauge, to be applied to the axle, after the round or conical ends have been turned, and the two parts welded together. The axle may be laid on a bench, and the gauge applied. This gauge consists of a straight bar of sufficient length, and it has on it three sliding pieces, capable of adjustment, which project at right angles from it. The extreme ends of two of these slides are to be so adjusted as to come into contact with one of the journals of the axle, one of them near its end, and the other near its shoulder; the third gauge piece, at the opposite end of

the long bar, being placed in contact with the opposite journal, near its shoulders. If these three points are in contact, and on being reversed are still in contact, the journals are true with each other; if not they require setting. The claim is to the mode of setting the axles, and to the apparatus as described.

Had we been engaged in the business of setting axles, we certainly should have resorted to some mode substantially the same with the foregoing, and should have done this without being sensible that we had made any invention or discovery.

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305. For an improvement in *Stoves*; Thomas Mills, Havanna, Chemung county, New York, September 25.

This is a species of box stove, for heating. The bottom, if bottom it can be called, consists of two plates, each reaching from near the lower edges of the side plates to the middle of the top plates, leaving an open space from front to rear of the stove, in the form of a common tent. There are ribs on the interior of the plates for the fuel to rest against. The fire chamber consists of two compartments, both of which are to be supplied with wood. The claim is to the making two chambers of combustion, by the arrangement of the plates as described; also to the projections on the insides of the plates, and double sunk hearths, in the manner in which they are combined.

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306. For improvements in the *Water Wheel, and the Mode of letting Water on the same;* Samuel Curtis, Eagle, Alleghany county, New York, September 28.

Perceiving nothing in this wheel to recommend it, as superior to others, and believing that instead of being so, it will disappoint the hopes of its projector, we shall give only the claim.

"The invention claimed by me consists in the manner of introducing the water inside the wheel, and causing it to act by percussion as well as reaction, as above described; and the mode of forming and adapting the buckets thereto."

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307. For an improvement in the *Mortise Latch for fastening Doors;* Charles S. Gay, Nashua, Hillsborough county, New Hampshire.

In this instrument a spring latch is protruded, and drawn back, by a knobbed handle in the ordinary way. The novelty consists in what is called a rotary guard, which is to be turned by means of a key, and which catches upon the bolt so as to prevent its being withdrawn until the guard is turned back again, thus making it answer the purpose of a lock. The claim is to this rotary guard. The latch deposited in the patent office is a good one, being well made, and not liable therefore to get out of order. As to the rotary guard, it will certainly answer the purpose intended perfectly well; few things, however, would be more easy than to devise a dozen modes equally good.

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308. For an improvement in the *Mortise Latch for Fastening Doors;* David N. Ropes, Portland, Maine, September 28.

This latch is a spring lifting latch, operating in the manner of the lifting latches which are used in the modern imported English patent door locks. It is made in a very simple manner, which is its only merit. The latch

part is made of iron, and upon the top part of this a narrow strip of steel is riveted which extends out behind it, and is firmly fastened to the box or plate of the latch. This spring forces the latch down, and it is raised by a lifter on a knobbed handle, in the usual way.

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309. For *Drafting out the fore part of Coats;* Allen Ward, city of Philadelphia, September 28.

We are informed by the patentee that "the following draft, or diagram of a coat will show the practical tailor how to produce the balancing points of coats according to the new method, with about half the labour usually bestowed for that purpose." Those interested in the invention or discovery may obtain the said drafts at the patent office. Were there any probability that this great improvement would lessen the charge to the consumer of coats, we would take some trouble to make it known, as this would be a balancing point of general interest; of this, however, we have no hope, but, on the contrary, apprehend a charge for the patent right.

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310. For an improvement in the *Machine for Cutting Leather;* Levi N. Leland, Grafton, Massachusetts, September 28.

This is a machine intended principally for cutting out the soles of boots and shoes. The leather is first to be cut into strips of a proper width; that is, equal to the length of the sole to be cut. A sliding frame, acted upon by a rack and toothed wheel, is placed upon a frame within the cheeks of which it slides horizontally. Knives of a proper curvature cross this frame from side to side, being held in grooves prepared to receive them. The edges of these knives are upwards, and are all on the same horizontal plane. A cylinder, which may be turned by any adequate power, crosses the machine above the edges of the knives, and has toothed wheels on each of its ends which take into the racks upon the knife frame. The cylinder is adjustable, and its periphery bears upon the edges of the knives. When the leather is passed between them, it will be cut, as desired, and will fall through between the knives.

The claim is to "the cylinder in connexion with the carriage under it, the slide placed in the carriage, and the knives inserted in the slide, and the mode of regulating them, as set forth."

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311. For an improvement in the *Endless Chain Horse Power;* Henry G. Hall, Putnam, Muskingham county, Ohio, September 28.

The difference between endless chain horse powers, for which patents are claimed, is frequently as small as that existing between cylinder thrashing machines. Care, of course, is taken in the office to confine the claims, in these cases, to those things which appear to be actually new, and, however small such a thing may be, if it have the character of novelty, and appears to be substantially different from what has preceded it, no more can be required; its importance is a question between the patentee and the public. The claim in the present instance is to an "additional link for strengthening the chain," so as more securely to bear the weight of the horse.

Specifications of American Patents.

Specification of a patent for a composition of matter for the manufacture of Fire Bricks; granted to Christopher W. Fenton, *Bennington, Vermont, September 22nd,* 1837.

The nature of my invention, or discovery, consists in mixing, in the manufacture of fire bricks, the following substances, to wit: the earth usually denominated kaolin, or porcelain clay, and fine granular quartz, or white sand, or sandstone, frequently, if not commonly, used in the manufacture of glass; which bricks, when shaped, and sufficiently dried, are baked in a high heat.

To enable others skilled in the art to make and use my invention, I will now describe the manner in which I proceed. I compose the said fire bricks of the said kaolin or porcelain clay, and fine granular quartz, being a species of pure white sand, or sandstone, as before mentioned, in equal parts, or in any other available proportion, though I prefer equal parts, or nearly so. These two substances being intimately mixed together and moistened with water, so as to bring the whole to a proper consistency, I then shape the mass into bricks, or other blocks, by the aid of moulds, after the common manner of making bricks. When these bricks are sufficiently dried I bake them in a high heat; they are then fit for use, and will resist a greater degree of heat than any other substance or composition of matter known to the inventor as applicable to this purpose.

What I claim as constituting my invention and discovery, and wish to secure by letters patent, is the using and applying the aforesaid substances, known under the name of kaolin, or porcelain clay, and granular quartz, being a species of white sand, or sandstone, frequently used in the manufacture of glass, in the manufacturing of fire bricks; which fire bricks are capable of resisting an intense heat; and I claim the composing said fire bricks of these substances in any proportion, be it in equal or unequal parts.

Christopher W. Fenton.

Remarks by the Editor. The testimonials respecting the goodness of the bricks made by the patentee are satisfactory upon that point, as they have been well tested, and compared with others, in iron furnaces. The term kaolin, or porcelain earth, is not a very distinctive one. The substance so called by us, is not identical with the true kaolin of China; and it will be found to differ in the proportion of its constituents in different localities; that used by the patentee offers no assurance therefore, that the material known by the same name in another place, will possess like refractory properties.

Specification of a patent for an improved current water wheel; granted to Warren P. Wing, *Greenwich, Hampshire county, Massachusetts, September 22nd,* 1837.

To all whom it may concern, be it known, that I, Warren P. Wing, of Greenwich, in the county of Hampshire, and State of Massachusetts, have invented certain improvements in the hydraulic current wheel, by means of which the flowing of a current, or tide, may be more efficiently applied than it has been heretofore to the raising of water,

or to other purposes for which power is required; and I do hereby declare that the following is a full and exact description thereof.

For the sake of facility of description I will give the form and dimensions of one which I have put into operation, and which has been found to answer well in practice. The wheel consists of a shaft upon which are placed flights, or buckets, against which the water is to strike and give motion to the shaft, the flights being placed obliquely thereon. The shaft of this wheel, is thirty feet long, and eight inches in diameter; its form is octagonal. Into four of the sides I insert seven flights or buckets, making twenty eight in the whole. At one end of the shaft the flights are twenty inches long, and at the other end forty, the intermediate flights increasing equally in length from the shortest to the longest. They are each about eight inches wide near the shaft, and spread out in a fan-like form, so that their extremities occupy about one eighth of the circle, or circumference, of the wheel. The flights or buckets are flat on the face and they are set so as to form an angle with the axis of the shaft, usually of about thirty degrees; but this angle will vary according to the velocity of the current, and accordingly as the shaft varies more or less from the line of direction of the current: a distinguishing characteristic of my wheel being the placing of the shaft so as to form an angle with the direction of the stream both vertically and horizontally. The buckets, or flights, may be of iron, or other material. The wheel is to be placed so far below the surface as to be out of the way of floating ice, &c.

The shaft, as above intimated, is to be placed obliquely to the direction of the current. In a wheel of the size mentioned it may vary about six feet from the direct line, both horizontally and vertically, by which means the force of the water upon the flights will be greatly increased. Two or more such shafts may be coupled together, and to prevent inconvenience from their great depth in the water, the angles of the shafts with the current may be reversed, so that whatever their number their depths below the surface will remain the same. From the gudgeons of the shafts the power may be communicated in any convenient way.

I do not claim as new the employment of wheels consisting of a shaft furnished with flights, or buckets, these having been used; but what I do claim is the increase of the length of the flights so as to give to the outside of the wheel the form of the frustrum of a cone; and also the placing of such shafts in the current so as to form a decided angle therewith, in the manner described.

WARREN P. WING.

Specification of a Patent for a process for protecting articles made of Iron or Steel from oxidation. Granted to M. SOREL, *of the city of Paris, in the Kingdom of France. December,* 1837.

To all whom it may concern; be it known, that I, M. SOREL, of the city of Paris, in the Kingdom of France, have invented, or discovered, a process, method, or methods, by which various articles made of iron or steel, may be effectually preserved from oxidation, or rusting, by the galvanic action produced by zinc, and I do hereby declare that the following is a ull and exact description thereof.

It is well known to chemists and to all persons versed in the physical sciences, that a galvanic action is produced by the contact of two metals different in their natures, and that the most oxydable of the two metals so brought into contact becomes positively electrified; whilst that which is least oxydable becomes negatively electrified, and also that, when brought into this state, the most oxydable, or positively electrified metal, has a tendency to become oxidized, and will abstract oxygen from compounds containing this agent; whilst the least oxydable of the two metals will be protected from oxidation, although exposed to agents which would oxidize it, but for the contact of the negative metal. My process depends, for its efficiency in protecting iron and steel from oxidizing, or rusting, upon the manner in which I apply this principle.

The process of covering articles of iron with tin is well known, and is exemplified, most largely, in the manufactory of what is usually known under the name of sheet tin, or tin plate, which consists of thin sheets of iron coated with tin. In this material there is necessarily galvanic action between the two metals, but it is to the disadvantage of that which it is proposed to protect, namely, the iron, which being more oxydable than tin, becomes positively electrified, and has its tendency to rust increased; the protecting effect of the tin depending in this case entirely upon the perfectness with which the iron is coated by it; as is clearly evinced by the rusting of the iron whenever any portion of this coating is removed, and the iron is exposed to the action of air and moisture. Were the galvanic action in favour of the iron, it would be protected notwithstanding the abrasion of the tin, as its protecting influence is not limited to the mere point of contact, but extends far beyond it.

In the scale of the oxidability of the different metals, commencing with those which are the most oxidable, it has been found that zinc stands before iron, and it follows, therefore, that when these two metals are brought into contact, a protecting influence will be exerted upon the iron by the zinc, and that the rusting of the former metal will be thereby prevented.

It might be supposed, from the fact that zinc is more oxidable than iron, that this metal, if employed to protect iron, would itself soon become oxidized, or rusted, and would, consequently, leave the iron unprotected; and such reasoning would undoubtedly be just, but for another fact, well known to chemists, that there are certain metals, of which zinc is one, which after they have acquired a thin superficial coat of oxide, are thereby effectually protected from the further absorption of oxygen, under ordinary exposure.

Having thus fully exemplified the principle upon the application of which my process is dependent for its efficacy, I will now proceed to give the necessary details, and the various modes which I have devised, for carrying the same into operation. These modes which I have essayed, are five in number, and are as follows:

First, applying the zinc to the iron or steel in the manner in which tin is applied in the process of tinning.

Second, applying a galvanic powder in the manner of paint, which consists in mixing the zinc, reduced to fine powder, with oils, or resinous materials, so as to form a paint or varnish, with which the substances to be protected are to be covered, in the ordinary manner of painting, or varnishing.

Third, covering the articles to be protected, with the galvanic powder, consisting of zinc finely comminuted.

Fourth, wrapping the articles to be protected in what I denominate galvanic paper.

Fifth. Anointing or covering the articles with a galvanic paste, consisting of any suitable fatty matters, such as purified lard, in which the galvanic powder has been freely mixed.

The first process, that of coating the articles to be protected with metallic zinc, is to be effected much in the same manner in which tinning is performed, that is to say, the articles to be coated must be rendered clean, and free from oxide, by processes analogous to those followed in preparing them for ordinary tinning; such as immersing them in diluted sulphuric or muriatic acids, scouring them, and so forth; which processes being well known, need not to be described. The zinc, in like manner, must be fused in proper crucibles, or other convenient vessels, adapted to the nature and size of the articles to be operated upon; special care being taken to keep the metal covered with sal ammoniac, or other proper flux; and to regulate the heat in such way as is required by the volatile nature of the metal. The articles to be coated, after being dipped into the melted zinc, are to be withdrawn slowly, that too much of the metal may not adhere to them. They are then to be thrown into cold water, rubbed with a sponge, or brush, and dried as quickly as possible, as otherwise they may be injured by the appearance of dark spots, which it is desirable to avoid.

When chains for cables, or for other purposes, are being withdrawn from the zinc, they must be shaken until sufficiently cooled to prevent the links from being soldered together by the melted metal. The coating of small chains requires careful management, but by the following procedure it is effected without difficulty. Whilst in the dilute acid, they are to be moved about to expose all their parts equally to its action, they are then to be dipped into muriatic acid, and immediately dried in a reverberatory furnace. The melted zinc being ready, and covered with sal ammoniac, the chains are to be put into it, and suffered to remain there about a minute; they are next slowly taken out by means of an iron skimmer, or other convenient instrument, which will allow as much of the zinc to drop from them as can be got rid of in that way; the links, however, will still retain too much zinc, and will be soldered together. To correct this they are to be put into a reverberatory furnace, to be covered with charcoal, and retained at a red heat for about a quarter of an hour, during which time they are to be moved about by means of an iron poker; by this treatment the excess of zinc will be discharged; they are then to be drawn towards the mouth of the furnace where they are kept in motion until the zinc is solidified. When small nails, and such like articles, are to be coated, the process should be performed in small crucibles, this being necessary to prevent the danger of spoiling a considerable portion of zinc, which results when iron has been kept in it for a considerable length of time, as it is thus rendered unfit for the purpose of a protective coating. In all cases the purest zinc should be employed. Wire may be coated by passing it through the melted zinc, as it is wound of from one drum or reel, on to another.

When articles of iron have been coated with zinc, it is sometimes desirable to cover this coating with one of tin; more especially when culi-

nary vessels are the subjects of the operation. It may also be resorted to when it is desired to give a brighter and more handsome surface than the zinc affords; such a coating of tin will not destroy the galvanic effect of the zinc; and it is to be effected in the ordinary way of tinning, particular care being taken not to heat the tin too highly, or to keep the articles in it so long as to remove any portion of the coating of zinc.

The galvanic powder, consisting of zinc reduced to that state, may be obtained by various means; the following, however, I have found to be the most economical of any which I have essayed.

The zinc is put into a reverberatory furnace, and brought nearly to a red heat, care being taken to prevent the access of a current of air; it is then carefully skimmed, and covered with sal ammoniac.

Iron filings, equal in weight to about one tenth part of the zinc, are to be moistened with muriatic acid, and thrown on the fused zinc; the whole is to be covered with finely pulverized charcoal, and the heat of the fused metal raised to whiteness, and so retained for a quarter of an hour, agitating it at intervals by means of an iron poker. The melted mass is then to be run off into a brick or cast iron reservoir, which is covered with a plate of cast iron, to prevent the combustion of the zinc. Through an aperture on the cover, a poker, or stirrer is to be introduced to agitate the alloy, which is to be done until it is cool, when it will be in fine powder.

The galvanic paint is prepared by grinding this powder with the fluid which is to be employed to form it into a paint, or varnish. Various fluids may be used for this purpose. I have sometimes employed the oil distilled from coal tar. Coal tar itself answers well, with the addition of one third of spirits of turpentine, or of a sufficient quantity to bring it to a proper consistence. For purposes where the odour of this mixture would be objectionable others may be substituted.

Articles of polished steel, or iron, packed in this galvanic powder, so as to be covered thereby, will be preserved from oxidation, even should they become moistened from any accidental cause.

Galvanic paper may be prepared either by the mixing of the powder with the pulp in the manufacturing of the article, or by taking the ordinary wrapping paper, coating it with any suitable adhesive substance, and sifting the galvanic powder over it. Polished, or other, articles, wrapped in such paper, will be effectually protected from rust by the galvanic action.

The preparation of the galvanic paste has been sufficiently explained, and its operation in protecting the articles coated with it will be readily understood, as it is analogous in this respect, to those previously described.

Having thus fully explained the principle upon which my process of protecting iron and steel from rusting, or oxidating, is dependant; and having also given the various modes in which I have contemplated the carrying the same into effect, I do hereby declare that what I claim as of my invention, and wish to secure by letters patent, is the employment of zinc, in various forms, as a covering to the respective articles to be thereby protected, as herein set forth. I do not claim to be the discoverer of the principle of the protection of metals from oxidation by galvanic action; nor do I claim to be the first to have proposed the employment of zinc for the preserving of iron therefrom; masses of zinc having been

applied, or it having been proposed to apply it in masses, to steam engine boilers, and probably to other articles, with this intention; but from this, my plan, or mode of procedure, differs as obviously as it surpasses it in efficiency, and in its applicability to numerous purposes in the arts where the application in masses would be impossible, or altogether unavailable.

SOREL.

Progress of Practical and Theoretical Mechanics and Chemistry.

Templemoyle Agricultural School.

Any one who duly reflects upon the infinite importance of giving to the youth of our country, an education wisely adapted to their prospects in life,—to the peculiar character of an American citizen,—to the nature of our Institutions,—to our social polity and republican habits,—must, we think, regret the failure of the bill so favorably introduced into the Legislature, and so ably supported, of establishing a School of Arts under the supervisions and management of the Franklin Institute. It might be difficult to add much to the arguments so forcibly urged by the principal advocates of the bill; and we cannot but believe, that extended observation and maturity of reflection will eventually satisfy every parent and guardian that he could make no better provision for the prosperity of a son or a ward, destined to fill an active and productive sphere of life, than to place him in a school where, in addition to the requisite amount of literary instruction, he may acquire a knowledge of those practical sciences, to which his time and energies must necessarily be devoted. Such a school as that whose outlines and objects were presented to the Legislature, would furnish incalculable advantages to those who have in prospect an engagement in any of the arts, trades and manufactories which are becoming so immensely important to the wealth of our country. To those whose views are more exclusively agricultural, such establishments as the one described in the subjoined article would be worthy of all imitation.

G.

To the Editors of the Irish Farmer's and Gardener's Magazine.

GENTLEMEN—You will render a service to Ireland, and advance the interests of that branch of her industry (agriculture) whence she derives her principal resources, by giving a place in your widely circulated pages to the following account of an establishment now in operation for ten years, the extension of which, and the formation of similar schools elsewhere, are the sole rewards aimed at by the noblemen and gentlemen who were the founders of it, of whom many are still zealous, as the committee of management, in promoting its success.

I have the honor to remain, Gentlemen, Your obd't humble serv't,

ONE OF THE COMMITTEE.

The Agricultural Seminary of Templemoyle originated at a very numerous meeting of the Northwest of Ireland Farming Society at Londonderry, and it was at first intended that it should consist of two establishments, taking Mons. Fellenberg's Institution at Hoffwyll in Switzerland in some degree as the model: the first to be a school affording instruction in every science and accomplishment aimed at by the children of the higher orders; the second for the education of the sons of respectable farmers and tradesmen, in the hope of disseminating the advantages of an improved system of

farming with greater certainty, by combining the practice and theory of it in the instruction of those who were afterwards to make agriculture their pursuit. It was hoped that the extended scale of the institution would have allowed of a greater variety of masters and lecturers, and that the profit derived from the superior school would have contributed towards the maintenance of the secondary one; but a short experience convinced the subscribers that such a scheme was impracticable without much larger and more certain funds than they could rely on; they then gave their undivided attention to the agricultural seminary, which through their increasing exertion has attained such eminence as may justly entitle them to look forward with confidence to its increasing usefulness, and to its becoming a model for establishments of a similar nature in other parts of Ireland.

The school and farm of Templemoyle are situated about six miles from Londonderry; about a mile distant from the mail-coach road leading from Londonderry to Newtowlimavady. The house, placed on an eminence, commands an extensive and beautiful view over a rich and highly cultivated country, terminated by Lough Foyle. The base of the hill is occupied by a kitchen and ornamental garden, cultivated by the youths of the establishment, under an experienced gardener. The ground between the garden and house is laid out in beds in which all the different grasses, clovers, &c., are cultivated with the greatest care. The house is in the form of an ||=||, with ranges of farming offices behind, containing spacious, lofty, and well ventilated school-rooms; refectory, dormitories, apartments for the masters, matrons, servants, &c.

Each pupil occupies a separate bed; the house can accommodate seventy-six, and the number of pupils amounts to sixty. They receive an excellent education in reading, writing, and arithmetic; book-keeping, mathematics, land-surveying, and geography. This department is managed by an excellent head master and assistant master, both resident in the house. The pupils are so classed that one-half are receiving their education in the house, while the remainder are engaged in the cultivation of a farm of 130 Cunningham or 165 statute acres, in the management of which they are directed by the head farmer, an experienced and clever man, a native of Scotland, who has a skilful ploughman under him. The pupils who are employed one part of the day on the farm, are replaced by those in the school, so that the education always advances in and out of doors *pari passu.*

The pupils are thus instructed in all the practical parts of farming, and are also lectured several times a week on the theory of agriculture. They are made acquainted with all the properties of different soils, the manures most applicable, and the crops best adapted to each; points in which most of our practical farmers display great ignorance. They are also made acquainted with all the numerous varieties of cattle, and their qualities, such as early maturity in some breeds, hardihood in others, and have strongly impressed on them that one of the most essential points in farming, is to select the cattle and the crops best adapted to the situation, soil, &c.

The stables, harness-rooms, cow-houses, winter-feeding houses, piggeries, barn, tool-houses, are arranged in the best manner, and the pupils are required to keep them and their contents in the highest order. A respectable and intelligent matron has the superintendance of the dairy, cooking, and cleaning the house, and the charge of the domestic servants.

The formation of this establishment has caused its founders an expenditure of above four thousand pounds; of which about three thousand were raised at its commencement by shares of £25 each, by the noblemen,

gentlemen, and members of the North-west Society. The Grocers' Company, on whose estate it is situated, have been most liberal in their assistance, and have earned a just reward in the improvement of their property, by the valuable example the farm of Templemoyle presents to their tenantry; and it is gratifying to state, that the example is not confined to so limited a circle, but is followed, to a very great extent, by the farmers to a considerable distance.

In sending a pupil to Templemoyle it is necessary to have a nomination from one of the shareholders, or from a subscriber of £2 annually. The annual payment for pupils is £10 a year; and for this trifling sum they are found in board, lodging, and washing, and are educated so as to fit them for land-stewards, directing agents, practical farmers, or surveyors, schoolmasters, or clerks.

From fifteen to seventeen is the age best suited for entrance at Templemoyle, as three years are quite sufficient to qualify a student possessed of ordinary talents and a knowledge of the rudiments of reading and writing, to occupy any of the above situations. If this very short and imperfect sketch of what must and will become a more generally useful institution, as it is more known and appreciated, should lead the reader to wish any fuller information, he may easily be gratified by visiting the agricultural seminary, or by applying to the zealous secretary to the committee, Pitt Shipton, Esq., Londonderry, under cover to Sir R. A. Ferguson, Bart., M.P., who will furnish printed reports containing the history of the rise and progress, the names of the shareholders, the rules and regulations of the society, hours of school and labour, dietary, and a variety of minutiæ, which, though extremely valuable and necessary to be known, yet from their length might prevent the insertion of this outline of the Templemoyle Seminary in those works which, from their circulation, may both increase the utility of the publication, and the knowledge of an institution of which the advantages have been felt and appreciated in the north of Ireland.

N.B.—Upwards of two hundred young men, natives of sixteen different counties in Ireland have passed through, or remain in, the school. Of these between forty and fifty have been placed in different situations, such as land-stewards, agents, school-masters, and clerks, or employed on the ordnance survey. Nearly one hundred are now conducting their own or their father's farms in a manner very superior to that of olden time; and the accounts of those who have been placed from the seminary are such as to gratify the gentlemen who have its interest at heart, and to convince them that the good seed sown is producing an ample and valuable harvest.

Templemoyle, Oct. 14, 1837.

[It gives us unqualified pleasure to lay before our readers the above gratifying account of an institution so eminently calculated to confer lasting benefits upon the country. We have been long strenuous advocates for the establishment of agricultural schools in all parts of Ireland, feeling assured that they would ultimately be the means of breaking down those absurd prejudices which have been hitherto the most insurmountable obstacles with which agricultural improvement had to contend.]—*Editors.*

Farmers' Magazine.

Statistical Tables of the Manufacturing Industry of Massachusetts.

The result of an inquiry into the actual number and amount of the various products of Industry within the state, has been returned by the assessors, in conformity to a law which enjoined this duty upon them. The

facts are returned as they existed on the first day of April, 1837, and have been arranged and published by JOHN P. BIGELOW, secretary of the Commonwealth. The report makes an interesting volume of 212 pages, 8vo. A condensed summary, as we find it at the close of the volume, we think will furnish acceptable information to most of our readers.

Articles manufactured or produced.	Value.	Hands employed	Capital invested.
Anchors, Chain Cables, &c.,	$ 114,125	36	$ 80,500
Axes, Scythes, Snaiths, &c.,	325,956	387	196,938
Beer, Bellows, Blacking, Boats and Wherries, Bricks,	152,321	273	55,300
Bonnets, (Straw) and Palm-leaf Hats,	1,902,803		
Books and Stationary, Pocket Books, and School apparatus,	1,048,140	1023	909,800
Boots and Shoes,	14,642,520	39.068	
Brass and Copper,	1,469,354	297	635,800
Britannia and Block Tin,	66,300	59	7000
Brushes, Brooms, and Baskets,	289,512	350	103,095
Buttons, of all kinds,	246,000	358	147,200
Candles, (Spermaceti and Tallow,) and soap,	1,620,730	266	697,300
Candlesticks, Playing Cards, Chocolate, Clocks, Chair Stuff, and Coffee Mills,	66.914	81	29,840
Cards, (Wool,)	254,420	139	148,340
Carriages, Wagons, Sleighs, Harness, &c.,	679,442	945	278,790
Casks and Hoops,	202,832	194	81,250
Chairs and Cabinet Ware,	1,262,121	2011	
Clothing, Neck Stocks, and Suspenders,	2,013,316	3939	780,158
Combs,	268,500	444	
Cordage and Twine,	481,441	439	285,375
Cotton Goods, (Cloths,)	13,056,659	19,754	14,369,719
Cotton Batting, Thread, Warp and Wicking,	169,221	151	78,000
Cotton Printing,	4,183,121	1660	1,539,000
Cutlery,	186,200	193	92,033
Drugs, Medicine, and Dye Stuffs,	371,019	97	98,995
Fishery, (Whale, Cod, and Mackerel,)	7,592,290	20,126	12,484,078
Fur Caps, and other manufactures of Fur,	73,000	100	55,000
Gas,	100,000	40	375,000
Glass,	831,076	647	759,400
Glue,	34,625	18	19,700
Gold and Silver Leaf,	43,000	36	11,200
Gunpowder,	246,357	77	160,800
Hats,	698,086	867	
India Rubber,	18,000	13	10,000

Articles manufactured or produced.	Value.	Hands employed	Capital invested.
Iron Castings, Bar and Rod, &c.,	1,658,670	1311	1,516,025
Jewellery, Silver, and Silver Plate,	325,500	207	161,550
Lead Manufactures, .	201,400	43	6400
Leather, including Morocco,	3,254,416	1798	2,033,423
Looking Glasses, .	165,500	58	61,600
Lumber, Shingles and Staves,	167,778	121	27,750
Machinery, of various kinds,	1,235,390	1399	1,146,775
Muskets, Rifles, Pistols, Swords, &c., . . .	288,800	394	65,943
Nails, Brads, and Tacks,	2,527,095	1095	1,974,000
Oil, (Refined Whale and other Oil,) . .	2,030,321	145	1,133,500
Organs and Piano Fortes,	324,200	239	172,000
Paper, . .	1,544,230	1173	1,167,700
Ploughs, . .	54,561	73	
Saddles, Trunks, and Whips,	351,575	758	109,825
Salt, . .	246,059	708	801,753
Shovels, Spades, Forks and Hoes,	264,709	284	225,523
Silk, . . .	56,150	125	137,000
Spectacles, Starch, Stone and Earthen Ware, . .	35,560	47	20,974
Spirits, . .	1,238,789		
Stone, (Granite, Marble, Slate and Soap Stone,) . .	680,782	1177	209,950
Stoves and Stove Pipe, .	31,000	13	11,815
Sugar, (Refined,) . .	976,454	92	303,653
Snuff and Segars, .	184,601	396	33,300
Tin Ware, . .	394,322	377	
Tools, (Carpenters', Joiners' and Shoemakers',) .	258,531	279	110,807
Types and Stereotypes, .	157,000	215	140,000
Umbrellas, . .	104,500	136	56,500
Upholstery, including Bed-binding, Curtains, Hair and Paper Hangings, . .	55,483	86	13,160
Vessels built in the five years preceding 1st April, 1837, .	6,853,248	2834	
Varnish and Beeswax, .	52,600	8	9000
Window Blinds, Sashes, and Doors	74,166	93	8350
Wire, . .	84,770	53	44,200
Wooden Ware, including Packing Boxes, Rakes, Shoe Pegs, Yokes and Helves, .	174,692	313	26,950
Wool, . .	539,689		2,842,778
Woollen Goods, .	10,399,807	7097	5,770,750
Engravings, Essences, Hosiery. Lamp-black, Mathematical Instruments, Mustard, Razor Straps, Lather Boxes, Pumps, Blocks, &c. &c., .	63,466	117	19,078
Total, . .	$91,765,215	117,352	$54,851,643

The preceding presents the grand total of the returns of the Assessors. It will be perceived that it includes vessels built in the *five* preceding years; all the other articles named having been manufactured or produced within *one* year preceding April last. Deducting the vessels from the above statement, and allowing one-fifth of the value set against them as the proper average for a *single* year, there will remain the sum of *eighty-six millions, two hundred and eighty-two thousand, six hundred and sixteen dollars*, as the value of the articles manufactured or produced by the several specified branches of industry, carried on by the citizens of this State, during the year ending April 1, 1837.

The population of the State, agreeably to the official returns, was on the first day of May 1837, 701, 331. That, of each of the 13 largest towns, was as follows: Boston, 80,325; Lowell, 18,010; Salem, 14,985; New Bedford, 14.304; Charlestown, 10,101; Lynn, 9,323; Springfield, 9,234; Taunton, 7,647; Roxbury, 7,493; Worcester, 7,117; Gloucester, 8,822; Cambridge, 7,631. The population of Nantucket was 9,048.

Taking the superficial extent of Massachusetts at 7250 square miles, (for we find it variously stated in geographical books) it appears that the population is verging very closely upon 100 to a square mile, which is allowing nevertheless nearly $6\frac{1}{3}$ acres to each individual. The whole number of sheep in the State was 374,614; the average weight of whose fleeces was $2\frac{7}{8}$ lbs. per head. Each labourer, as is evident from the table, produces an amount of manufactured goods, worth more than 700 dollars, and the whole amount is nearly double that of the capital invested. Such statistical returns from each of the States, furnished at intervals of five years, would afford highly interesting data, and if consigned, as in this case, to the care of assessors, the information might be obtained in the most correct, cheap and effectual manner. G.

On a new Property of the Iodide of Silver. *By* H. F. Talbot, Esq., F.R.S.

It is well known that certain metallic oxides and salts have the property of changing their colour when heated, and recovering it again when cold.

The iodide of silver affords an extremely remarkable instance of this, and yet, I believe, the fact is not mentioned by any chemical author. I have no doubt, therefore, that a short notice of it may possess some interest.

Let a sheet of white paper be washed over with a solution of nitrate of silver, and afterwards with a *rather dilute* solution of hydriodate of potash. it will immediately assume a pale yellow tint, owing to the formation of Iodide of silver. The paper may then be dried and laid aside for use.

When the property in question is to be exhibited, the paper is held for some moments before a hot fire, and its colour changes from a pale primrose tint, to a rich gaudy yellow, emulating the sunflower.

Removed from the fire, this bright colour gradually fades away, and in three or four seconds it is entirely gone. It may then be reproduced, and again destroyed as before, and so on for any number of times, for the heat causes no alteration in the substance experimented upon.

When the paper is warm and very yellow, if the finger is pressed upon it and quickly removed, it leaves a print, or impression, of its shape, which is nearly white. The cause of this is, that the finger is a much better conductor of caloric than the atmospheric air, and therefore cools the paper in an instant of time. Any cold substance may be substituted for the finger,

and the effect can be produced at a little distance, without actually touching the paper, merely by the radiation of the cold body. It appears therefore, that this substance, from the peculiar suddenness with which it changes colour, is well adapted for experiments on the radiation and conduction of heat.

If now we throw some drops of ammonia on the paper, it turns white, and if we hold it to the fire we find that it has lost the power of changing colour. Gradually however the ammonia evaporates, and then the alternations of colour occur as before. This seems to prove that the alkali enters into chemical combination with the iodide, and possibly the white substance is the double iodide of silver and ammonia. This opinion is confirmed by observing that potash and soda act in a similar manner, giving rise to *permanent* white compounds unchangeable by heat, which are probably the double iodides of silver and potassium, and silver and sodium.

This is the reason why the paper was directed to be washed with a *rather dilute* solution of hydriodate of potash; for if we use a concentrated solution the resulting tint is white, and the colour of the paper is not changeable by heat.

I have kept some pieces of this prepared paper for a year or two, and find that it still remains as sensitive to heat as ever.

Lond. & Edin. Philos. Mag.

Dr. Lardner's Steam Engine Indicator.

At the last annual meeting of the British Scientific Association, held at Liverpool, a grant of money was placed at the disposal of a committee, to investigate the actual performance of steam vessels with reference to their speed, consumption of fuel, and other circumstances affecting their general efficiency. This investigation arose from a discussion which took place in the mechanical section, in the course of which statements the most conflicting were made, even by practical men, as to the capabilities of steam vessels for extended navigation. In prosecuting their inquiry, the committee have thought it desirable to adopt some method of registering the actual performance of the vessel in a log, which will not be subject to the errors and neglect which have hitherto rendered all steam-logs more or less useless.

With this view Dr. Lardner has attempted to construct a piece of mechanism, which will enable the steam-engine itself to write the journal of its own proceedings. This mechanism is now being constructed, and is intended to be placed in the "Tagus," a large and powerful steam-ship belonging to the Peninsula Steam Navigation Company,—this Company having liberally offered to co-operate with the committee.

The circumstances on which the efficiency of the machinery and the vessel principally depends, and which it is necessary to register, are the following:—

1. The height of the barometer-gauge, which indicates the state of the vacuum produced by the condenser.
2. The height of the steam-gauge which indicates the actual pressure of steam urging the piston.
3. The height of the steam-gauge which indicates the actual pressure of steam in the boiler.

4. The number of revolutions of the paddle-wheels per minute.
5. The depth of water in the boiler.
6. The degree of saltness of the water in the boiler.
7. The rate of the vessel.
8. The draught of the vessel, or her immersion.
9. The direction and force of the wind.
10. The course of the vessel.

The mechanism now being constructed will keep a self-recording register of the first six of these. A provision is, however, made for subsequently adding means of registering the seventh and eighth, should it be found desirable to do so. The consumption of fuel will be easily determined by keeping an account of the quantity of coals delivered into the vessel at each port, making an allowance for what is consumed in the steward's room, kitchen and cabins.

A float is placed on the mercury in the barometer-gauge, from which a rod proceeds, to which the pencil is attached. As the column of mercury rises or falls the pencil receives a corresponding motion, and, being pressed against the paper on the cylinder leaves a trace upon it, which measures the extent of the variations of the mercurial column.

The heights of the steam and other gauges are registered in the same manner by other pencils.

The entire apparatus will be enclosed in an octagonal case, about three feet and a half high, and three feet diameter. It will be locked by the agents of the owners when the vessel starts on her voyage, and will not be opened till her return. It will require no other attendance during the voyage than that of winding the clock.

The several pencils will be of different colours, so that their traces may be easily distinguished one from the other. Besides which it will be so arranged that their play may be confined to different parts of the cylinder.

At the end of each voyage the paper will be removed from the cylinder, and replaced by a clean sheet.

If it be thought advisable, the indications of the several curves traced by the pencils may afterwards be translated into the ordinary language of log-books.

It is not improbable that an anemoscope and other apparatus may be contrived, by which the direction of the wind and the course of the vessel may likewise be recorded, at least with as much precision as they are now ascertained by other and less regular expedients.

If this mechanism should succeed in attaining the objects for which it has been contrived, besides its valuable scientific results, it will be productive of great benefit to the proprietors of steam ships, by supplying to them a never-failing check on every one concerned in the management of the vessel. Thus any relaxation of attention, or want of skill, on the part of those in care of the fires, will be indicated by the third pencil. Any neglect in feeding or blowing out the boilers will be indicated by the fifth and sixth pencils. The attention to the state of the condensing apparatus will be shown by the first pencil.

In the event of the temporary suspension of the operation of the machinery for adjustment, or any other cause, the fact of such suspension, its duration, and the time it took place, will be also recorded.

By the connexion of all the indicators with the time-piece, the exact hour, or indeed minute, of each registered circumstance will be recorded.—*Monthly Cron.* Lond. Mech. Mag.

Astronomical and Mathematical Instruments.

The Rev. Dr. Robinson, the celebrated astronomer of Armagh; who left England in September last, to visit the principal observatories of Bavaria, Italy, and France, and also to inform himself of the actual state of the art of astronomical instrument-making in those countries, has arrived in London. The observatories he visited on his route, were those of Manheim, Munich, Milan, Turin, Modena, Florence, and Paris. The workshops he saw in detail, were those of Ertel and Son, of Munich, and Gambey of Paris. The mechanical intelligence of the proprietors of these establishments, before which those of our English instrument makers dwindle into insignificance—the unreserved manner in which they severally communicated the various processes of the art they so pre-eminently cultivate, and the extraordinary beauty and accuracy of their work when finished, have excited in him (than whom no individual is better able to appreciate their value) the greatest admiration. As to the latter—namely, the exquisite workmanship of their instruments, the doctor states that British astronomers will soon have an opportunity of judging for themselves, as two of the meridian circles of Ertel and Son, are in progress; the one for the observatory of Mr. Cooper, M. P., for the county of Sligo; the other for the observatory at Glasgow. The circles of these instruments will be of three feet diameter, divided to two minutes, and, by achromatic micrometer microscopes, magnifying thirty times, these two minutes are subdivided so that an error in reading, amounting to a quarter of a second, can scarcely be committed. Mr. Cooper's instrument will have eight microscopes, and a telescope of nine and a half feet focus, and seven and a half inches aperture. This instrument, ordered only whilst Doctor Robinson was at Munich, will be erected immediately after the meeting of the British Association at Newcastle, in August next, at which Mr. Ertel, as well as Mr. Gambey, will be present. The Glasgow instrument is of the ordinary construction, such as are to be found, made by the same artists, in the observatories of Altona, Konisberg, Dorpat, St. Petersburgh, &c.; four microscopes, however, being substituted in lieu of verniers. The doctor also speaks in the highest terms of the workshops of Mr. Gambey, whose beautiful dividing can alone be compared to that of the Munich artists. Min. Journ.

Lightning Conductors for Ships.

Mr. Editor,—I have read with much interest the scientific papers of your learned correspondent, W. S. Harris, Esq. F. R. S., upon the imperfect construction of the lightning conductors at present in use on board ships, and his comments upon a more perfect application of the results of science, as a defence against danger, which were elucidated in your last number by a diagram.

You will perhaps allow me to suggest, that a perfectly connected conductor may be obtained, according to the laws of electricity ex-

pounded by Mr. Harris, by the employment of copper wire, laid up after the manner of the wire rope lately introduced.

To fit a conductor in this way, it would be simply necessary to make one end fast at the masthead, and lead the other down into the water, by an out-rigger clear of the side. I conceive that the advantages of this plan, over that already proposed, are these: its simplicity of construction; its facility of being shifted when a spar is carried away, or when it is necessary to send a mast down; and that it can also be easily coiled up, and stored in a small compass, when out of use.

I believe the power of a conductor is measured by its extent of surface; and if this be correct, the rope of many wires would have a greater metallic surface than a bar of the same size, be at least as effective for the purpose as the connected lamina proposed by Mr. Harris, to whose consideration I have the pleasure, as a practical seaman, of offering my suggestions.

I am, Sir, &c.

E. Routh, H.C.S.

Jerusalem Coffee House, Nov. 4th, 1827.

Naut. Mag.

Anti Dry-rot.

The following letter has been addressed to the secretary of the Anti Dry-Rot Company, by Mr. Samuel Beazley, the architect.

"Sir:—At the commencement of the year 1836, I surveyed and accurately examined the posts and paling in the Regent's-park, for the purpose of ascertaining the comparative states of those timbers which had been prepared by Kyan's patent, and those which had not been submitted to the process of solution. In my report of that period, I stated that indications of decay were already perceptible in most of the unprepared timbers, both at the bottom of the posts, and in those arris edges and ends of paling which were placed, or had come at all, in contact with the earth, while those timbers which were marked as having passed through the solution, were quite free from any such symptoms. I now beg leave to state, that I have this day, after a lapse of two years and a quarter from my previous survey, again accurately examined several of the same posts and paling, digging away the earth from the foundations for that purpose, and find that the symptoms of decay mentioned in my preceding report as having commenced in the unprepared timber, have so considerably increased, as to have rendered the bottoms of the posts completely rotten, to a depth of from one to two inches, and that, in several instances, fungi have been the consequences of the decay; while I find the prepared timbers which are in the earth sound and in the same state, with the exception of mere discolouration upon the surface, probably arising from the damp state of the earth at the time of its removal. As a farther proof of the difference existing between the unprepared and the prepared timber, we could cut with the greatest ease large pieces from the former with the spade, without using any force, while it required great exertion to chip off very small pieces from the latter."

Min. Journ.

Improvement in Window Sashes.

Mr. R. B. Cooper, inventor of the patent spherical stoppers for bottles, jars, &c., the styloxynon, and several other useful articles, has just devised a most ingenious method of superseding the counterpoises and sash lines for windows. The principle will be invaluable in one of its proposed applications, viz: to the windows of stage coaches, omnibusses and railway-carriages; for as there is no *shake*, the present disagreeable and eternal rattle of the windows will be for ever silenced, and conversation rendered audible within the carriages, while carried on in the ordinary tone of voice. As it is probable that a patent will be secured for this simple and effectual contrivance, it would be unfair to enter into any further particulars at this time; suffice it to say, the proposed method is not only superior to, but also actually cheaper than, the old fashioned method of fitting and hanging windows.

W. B.

London, March 12, 1838. Lond. Mech. Mag.

Progress of Physical Science.

Security of Electric Jars from fracture by discharge.

The very frequent destruction of electric jars by perforation, splintering, or fracture, on being discharged at a high intensity, is a source of great annoyance and discouragement to the practical electrician. It is seldom, perhaps, that a battery is discharged after high excitement, without the fracture of one at least of its component jars. An investigation of the cause of this common occurrence has been made by W. Sturgeon, editor of the Annals of Electricity, whose experience in this department of Physics is probably as extensive as that of any person living. Jars are frequently broken by the injudicious practice of placing one knob of the discharger against the side of the jar, while the other knob is made to approach the ball at the top of the jar. It is better to place the jar, when charged, on any good conducting substance, such as a piece of tin foil, or metallic sheet of any kind, and in discharging, to connect this sheet with the ball of the jar.

The fracture, or star, almost always occurs near the top of the lining. From this it was inferred that "the fluid strikes the wire from the upper parts of the lining in almost every discharge from high intensity; and that those jars which are not broken owe their safety to the strength of the glass."

The remedy prescribed, and the results, I give in the author's own words. G.

'The electric fluid in the interior of an intensely charged jar indicates the greatest tendency to escape from the top of the lining; and that by the present mode of fitting up jars, an explosion from that part of the lining to the wire probably takes place whenever the jar is discharged through good conducting media, it seemed the most natural method, to *lead* the fluid, as it were, by some good conducting substance by the nearest route, and dispense altogether with the wire and chain that are suspended in the axis of the jar. For this purpose, two slips of tin-foil were secured to the opposite sides of the jar, and reached from the upper edge of the *lining* to the cover on the top; the under part of which was also covered with foil. This latter portion of the foil communicated with the lower extremity of the wire which supports the ball: so that a complete and direct metallic connexion

now existed between the top of the lining and the ball on the top of the jar. Therefore, no explosion in the interior of the jar could possibly take place. The result was, that every jar so fitted up has hitherto withstood the most severe trial. I have, for the last twelve years, employed jars thus protected, without ever breaking one by a discharge: although, during that period, I have discharged a battery of twelve jars some hundreds of times from the most intense electrization. I have called the slips of foil *protectors*: and I am firmly persuaded, that the most extensive battery may, by this means, be perfectly protected.

The next question that naturally presents itself, is, does the insulation continue as perfect in jars thus protected, as in those fitted up in the usual way?

Upon attentive examination, it will be found that the ball and wire of the ordinary jar, must always be electrized equally with the lining with which they are connected by means of the chain; and therefore the insulation from the lining to the coating, in such jars, can only be from the centre of the cover through which the wire passes to the upper edge of the coating: and as the cover is of wood, which is always a partial conductor, it also becomes charged in common with the wire and lining. Therefore, the only perfect insulation is that between the edge of the cover and top of the coating—exactly the same as in jars furnished with protectors.

When jars are cylindrical throughout, no covers need be used. A disk of wood of nearly the same diameter as the interior of the jar, is fixed by wedges of cork at the same height as the top of the lining. This disk is covered with tin foil, and the lower end of the wire carrying the ball is screwed into its centre. In addition to the cork wedges, I usually support the disk by three wooden rods, which rest on the bottom of the jar.

It is not my intention, however, to press the theoretical part of this paper too strongly on the attention of the society; because I am well aware that, unless experiments were made to show that the fluid actually leaps from the upper edge of the lining to the axial wire of ordinarily fitted up jars, it might lead to unnecessary doubts in the minds of those who have paid but little attention to the pursuit of a cause whose effects are the most disheartening that the amateur electrician has to contend with.

I have pointed out what has appeared to me to be the cause of these accidents to jars; and have briefly described the mode of investigation, both mental and experimental, which I pursued: and, whether my theoretical views be considered satisfactory or otherwise, the simple fact, alone, of my not having broken even one jar, thus fitted up, although I have constantly employed them for the last twelve, or more, years, during which, but few have had more extensive practice, may, perhaps, be sufficiently important to induce other electricians to adopt the same mode of protecting *their* jars which, for so long a course of practice, has afforded a complete protection to mine. If I have succeeded in this particular, the principal object for offering this paper to the notice of the Electrical Society will then be accomplished.

Annals of Electricity.

Concomitance of Chemical, and Vital, with Electrical Action.

M. Becquerel has described a most simple apparatus for the development of electricity, consisting merely of a syphon filled with fine sand, and having one leg filled with an acid, the other with an alkaline solution. These fluids meet at the most depending part of the tube, where there is an orifice plugged by a bit of asbestos, which conveys away the compound solution as fast as formed. Wires placed in the two legs

indicate strongly opposed electrical states, and the voltaic current thus produced, continues until all the fluid elements have been united. It is impossible to consider this result without acknowledging the remarkable influence which *capillarity* must have over chemical action, a condition so evident and constant in organized beings.

The late researches of Dr. Faraday have fully proved the identity of electrical with chemical affinity, and that all chemical changes are attended with a disturbance of electric equilibrium. If therefore the changes occasioned by the growth of organized systems are immediately governed by laws similar to those of inorganic matter, we should expect to find that electricity is constantly being developed by them, in the same manner as we, artificially, obtain it by chemical decomposition, or recomposition.

There is no deficiency of evidence that this is the case. During the germination of seeds, the two principal changes are the rejection of carbonic and acetic acids; and it has been recently ascertained that there is at the same time a manifestation of electric action. The seed may indeed be considered an electro-negative system, retaining the bases and rejecting the acids; and it has been accordingly found that grains applied to the negative extremity of a voltaic pile, germinate much more rapidly than those uninfluenced; and that positive electrical influence retards the process. In like manner, slightly alkaline solutions accelerate, and acids delay or altogether check it. In the later periods of vegetable growth, the contemporaneous chemical changes are by no means uniform in character; and it is probably from this cause that artificial currents of electricity do not seem to assist the growth of plants, although atmospheric electricity, which is undoubtedly much connected with the processes of vegetation, appears to accelerate it. That there is constant electric disturbance during the growth of plants, has been fully proved by the experiments of Pouillet; and by many writers, the changes produced by the exhalation of fluid, and the gaseous alterations effected by the leaves, are believed to be the main sources of the constant variations in the electric state of the atmosphere.

The connexion of *capillarity* with electric action has been already noticed; but some other facts may be briefly stated. Various substances having minute, porous structure, possess the power of occasioning the union of oxygen and hydrogen at comparatively low degrees of heat; thus spongy platinum will produce this effect at common temperatures, and charcoal, or porcelain biscuit, at about 300°. It does not seem very clear to what this power is to be attributed; and we are almost equally in the dark regarding the phenomena of endosmose, in which electricity would appear to have some share, the known laws of capillary action not being adequate to explain some of the recently observed facts.*

Many facts corresponding with those to which we just now alluded as having been obtained with regard to the electrical state of different organs of animals, have been remarked in vegetables also. Thus it has been ascertained that wires passed into the pith, and applied to the bark, indicated opposite electrical states; and the same is true of the two extremities of most fruits. Some of the most interesting proofs of the occurrence of electric actions in plants are derived from the experiments of M. Becquerel and Mr. Crosse, on the effect of currents of voltaic electricity of very feeble intensity, in producing the crystallization of

* Cyclopedia of Anatomy, p. 110.

many substances, which, from their insolubility, the chemist has been hitherto unable to procure in that form, but which occur abundantly in vegetables, such as silex, and the carbonate and oxalate of lime. Now, unless we suppose that vital affinity, or action, possesses this remarkable property in common with electricity, a supposition which appears entirely gratuitous, we cannot hesitate to set down the deposit of these salts in a crystalline state in the vegetable tissues, to the electricity developed by other chemical actions going on in the plant.—*W. B. Carpenter.*

Ed. New Phil. Journ.

Stratification of Minerals by Voltaic Electricity.

The following experiments are stated by William Norris, in Sturgeon's Annals of Electricity, to have been performed by Mr. John Leathart of Alston, Cumberland. They are in confirmation of those described by Robert Were Fox, Esq.*

Portions of different rocks were reduced to a fine powder and mingled together with water into a homogeneous mass, of the consistence of soft clay, or mud. After being subjected to the action of a current of electricity from ten days to a fortnight, these compounds were separated into distinct layers or strata of the different rocks which had been mixed together; the line of division between the strata being at right angles to the direction of the current.

A variety of interesting phenomena were observed in the course of these experiments. In one case blue limestone was separated from an equal quantity of argillaceous matter, with which it had been mixed, and was converted into white marble. In another experiment, portions of carboniferous (blue limestone,) siliceous (brown freestone,) and argillaceous (plate or shale) rocks were mixed together. The limestone was collected at the positive, or zinc, end, the plate at the negative, and in the centre the freestone formed a stratum having the appearance of white quartz. Ibid.

Effects of the Lightning on the Melville Monument, struck on the 14th of July, 1837.

The following particulars are curious:—The door which leads to the outer plinth at the top of the monument, immediately below the statue, fell to the bottom the instant the monument was struck; but, upon being inspected about three-quarters of an hour afterwards, there did not appear any of the usual effects of the electric fluid upon the ironwork or otherwise. The key of the door below, which leads to the top of the monument, was obtained, and upon entering it no appearance of damage could be discovered. On reaching the top of the stair, however, it was found that the stones which form the apex of the central part of the monument, upon which the stair rests, and which are perforated from the cupola to the bottom, on purpose to admit the conductor, were dislodged. The conductor was a chain, part of which was discovered still hanging at the top of the cupola, immediately underneath the statue. The rest of the chain was not to be seen, but upon descending to the bottom, and looking underneath the centre, upon which the stair is fixed, the chain was found in a heap, quite hot, and having a white calcined appearance. It would appear, therefore, that the door had

* Journal Franklin Institute, page 251, Vol. XXI.

not been struck by the lightning, but had been forced out by the concussion, arising from the aperture, which leads down through the centre of the stair from the top of the monument, being too small to admit the shock; which circumstance, causing a momentary interruption, had had the effect of dislodging the stones at that place for a couple of yards, wresting the door from the hinges, and breaking the chain. From all these circumstances it would appear that the conductor saved the monument.—(*Caledonian Mercury.*)

Archi. Mag.

Mechanics' Register.

Astonishing facts relative to a former Organic World.

"Dr. Buckland now proceeds to the most important and popular branch of his subject—to give a description of the most interesting fossil organic remains, and to show that the extinct species of plants and animals which formerly occupied our planet, display, even in their fragments and relics, the same marks of wisdom and design which have been universally recognized in the existing species of organized beings.

"After giving some account of the supposed cases of fossil human bones, and establishing the remarkable fact of the 'total absence of any vestiges of the human species throughout the entire series of geological formations," our author passes to the general history of fossil organic remains:—

"'It is marvellous that mankind should have gone on for so many centuries in ignorance of the fact, which is now so fully demonstrated, that no small part of the present surface of the earth is derived from the remains of animals that constituted the population of ancient seas. Many extensive plains and massive mountains, form, as it were, the great charnel-houses of preceding generations, in which the petrified exuviæ of extinct races of animals and vegetables are piled into stupendous monuments of the operations of life and death, during almost immeasurable periods of past time. "At the sight of a spectacle," says Cuvier, "so imposing, so terrible as that of the wreck of animal life, forming almost the entire soil on which we tread, it is difficult to restrain the imagination from hazarding some conjectures as to the cause by which such great effects have been produced." The deeper we descend into the strata of the earth, the higher do we ascend into the archæological history of past ages of creation. We find successive stages marked by varying forms of animal and vegetable life, and these generally differ more and more widely from existing species as we go further downwards into the receptacles of the wreck of more ancient creations. * * * *

'Besides the more obvious remains of testacea and of larger animals, minute examination discloses, occasionally, prodigious accumulations of microscopic shells that surprise us no less by their abundance than their extreme minuteness; the mode in which they are sometimes crowded together may be estimated from the fact that Soldani collected from less than an ounce and a half of stone, found in the hills of Casciana, in Tuscany, 10,454 microscopic chambered shells. * * * Of several species of these shells, four or five hundred weigh but a single grain; of one species he calculates that a thousand individuals would scarcely weigh one grain.'

"Extraordinary as these phenomena must appear, the recent discoveries of Ehrenberg, made since the publication of Dr. Buckland's work, are still more marvellous and instructive. This eminent naturalist, whose discoveries respecting the existing infusorial animals we have already noticed, has dis-

covered fossil *animalcules*, or infusorial organic remains; and not only has he discovered their existence by the microscope, but he has found that they form extensive strata of tripoli, or poleschiefer (polishing slate,) at Franzenbad, in Bohemia—a substance supposed to have been formed from sediments of fine volcanic ashes in quiet waters. These animals belong to the genus Bacillaria, and inhabit siliceous shells, the accumulation of which form the strata of polishing slate. The size of a single individual of these animalcules is about 1.288th of a line, or the 3400th part of an inch. In the polishing slate from Bilin, in which there seems no extraneous matter, and no vacuities, a cubic line contains, in round numbers, 23,000,000 of these animals, and a cubic inch 41,000,000,000 of them. The weight of a cubic inch of the tripoli which contains them is 270 grains. Hence there are 187,000,000 of these animalcules in a single grain; or the silicious coat of one of these animals is the 18,000,000th part of a grain!

"Since this strange discovery was made, Mr. Ehrenberg has detected the same fossil animals in the semiopal, which is found along with the polishing slate in the tertiary strata of Bilin, in the chalk flints, and even in the semiopal or noble opal of the porphyritic rocks. What a singular application does this fact exhibit of the remains of the ancient world! While our habitations are sometimes built of the solid aggregate of millions of microscopic shells—while, as we have seen, our apartments are heated and lighted with the wreck of mighty forests that covered the primeval valleys—the chaplet of beauty shines with the very sepulchres in which millions of animals are entombed! Thus has death become the handmaid and the ornament of life. Would that it were also its instructor and guide!"—*Ed. Review.*

Min. Jour.

LUNAR OCCULTATIONS FOR PHILADELPHIA, SEPTEMBER 1838.

Day.	H'r.	Min.	Star's name.	Mag.	Angles reckoned to the right or westward round the circle, as seen in an inverting telescope. For direct vision add 180° — from Moon's North point.	from Moon's Vertex.
1	13	54	Im. χ Capricorni	5,6	149	189
1	14	47	Em.		271	317
5	12	0	Im. (189) Piscium	,6,	169	139
5	12	53	Em.		270	254
8	12	20	Im. 9 Tauri	,6,	161	104
8	13	6	Em.		256	200
8	16	51	Im. *b* Pleiadum	,5,6,	155	175
8	17	52	Em.		251	295
8	17	22	Im. *d* Pleiadum	,5,	91	125
8	18	38	Em.		308	359
8	18	5	Im. σ Tauri	,3,	104	148
8	19	23	Em.		291	347
11	12	6	Im. *c* Aurigae	,6,	112	64
11	12	59	Em.		261	208
11	14	7	Im. 54 Aurigae	,6,	153	95
11	14	44	Em.		221	162
18	3	12	25.4s Begin.* Solar Eclipse		235	278
18	4	30	18.7s Begin. Ring			
18	4	32	44.7s nearest approach of Centres			
18	4	35	10.7 end of Ring			
18	5	44	38.0 end of Solar Eclipse		56	107

*See August Number for 1837 of this Journal.

House Painting.

A very simple method has lately been adopted to render the surface of paint perfectly smooth, and eradicate the brush marks. It is done by a small roller covered with a cloth, or felt, eight inches long and two inches in diameter, worked in an iron frame on pivots, similar to the common garden roller. The flatting coat by this method is made beautifully even, and looks exceedingly well. (*Athenæum*, Nov. 4, 1837.) Archit. Mag.

Harefield Copper and Zinc Works.

The great novelty in these works seems to be the fine process of manufacturing sheet zinc, which the company have been the first to bring to perfection in this country. The use of plates of malleable zinc is now becoming very general; and seems, indeed, to be universally introduced in the modern system of building. It is fast taking the place of copper in many instances, and of lead and tin in many more, being so much cheaper and lighter than the two former. Thus, copper is about 102*l.* per ton: sheet zinc about 25*l.* per ton. Lead is the same price as the zinc, but requires to be four times thicker when laid down, which, of course, makes it three-fourths dearer.—*Monthly Repository.* Ibid.

Meteorological Observations for March, 1838.

Moon.	Days.	Therm. Sun rise.	Therm. 2 P.M.	Barometer. Sun rise.	Barometer. 2 P.M.	Wind. Direction.	Wind. Force.	Water fallen in rain.	State of the weather, and Remarks.
				Inch's	Inch's			Inches.	
	1	16	32	30.96	30.00	W.	Moderate.		Clear—do.
	2	21	35	29.85	29.96	NE.	do.		Partially cloudy—do. do.
☾	3	20	34	30.15	30.20	N.	do.		Partially cloudy—cloudy.
	4	23	39	29.76	20	NW.	do.		Clear—do.
	5	32	36	85	29.45	E.SE.	do.	.90	Snow—rain
	6	36	49	65	76	W.	do.		Clear—do.
	7	34	38	80	80	E.	do.		Snow—drizzle.
	8	33	36	80	65	E.	do.	.55	Drizzle—rain.
	9	33	49	90	90	W.	do.		Cloudy—do.
	10	35	48	30.15	30.15	W.	do.		Clear—do.
☉	11	33	48	00	29 87	W.	do.		Clear—lightly cloudy.
	12	37	33	29.80	90	W.	do.		Clear—flying clouds.
	13	32	54	30.05	30.10	W.S.	do.		Clear—do.
	14	32	54	00	00	NW.	do.		Clear—cloudy.
	15	40	58	29.85	29.80	W.	do.		Cloudy—clear.
	16	42	56	80	80	N.	Blustering.		Cloudy—cloudy.
	17	36	43	78	75	E.	do.	1.25	Rain—rain and snow.
	18	32	34	55	56	NE.	do.	.05	Snow—do.
☽	19	32	42	55	55	W.	Moderate.		Clear—do.
	20	37	56	56	56	W.	do.		Clear—do.
	21	38	54	70	90	NW.NE.	do.		Cloudy—lightly do.
	22	36	43	30.10	30.10	E.	do.		Cloudy—do.
	23	39	46	20	15	W.SW.	do-		Cloudy—do.
	24	37	67	29.93	29.90	SW.	do.		Cloudy—lightly do.
⊗	25	38	50	30.20	30.24	W.N.	do.		Cloudy—clear.
	26	38	68	05	05	W.	do-		Clear—clear.
	27	39	48	05	29.85	E.	do.	.05	Lightly cloudy—shower.
	28	32	42	00	30.05	E.	do.		Cloudy—do.
	29	36	48	29.45	29.40	W.	Blustering	.09	Rain—flying clouds.
	30	36	56	50	50	W.	Moderate.		Clear—do.
	31	40	57	60	60	SW.	do.		Cloudy—clear.
	Mean	33.71	47.51	29.86	29.88			2.87	

		Thermometer.	Barometer.
Maximum height during the month.		68.00 on 26th.	30.75 on 23rd,
Minimum	do.	16.00 on 1st.	29.40 on 29th.
Mean	do.	40.61	29.87

ADDRESS

OF THE

COMMITTEE ON PREMIUMS

AND

EXHIBITIONS

OF THE

Franklin Institute of the State of Pennsylvania,

FOR THE

PROMOTION OF THE MECHANIC ARTS.

To the Manufacturers and Mechanics of the United States.

The Committee on Premiums and Exhibitions of "*The Franklin Institute of the State of Pennsylvania for the promotion of the Mechanic Arts,*" beg leave respectfully to announce that the *Tenth Exhibition* of American manufactures, under the care and direction of the Institute, will be held at the Masonic Hall, in the city of Philadelphia, from the 5th to the 9th of November next.

The object of these exhibitions is to bring together the various productions of American ingenuity, skill, and industry; to draw thereby the attention and patronage of the public to the useful arts; to excite a commendable spirit of emulation among workmen in the various branches; and to give rewards to excellence by the distribution of premiums.

It would be impossible to enumerate the various objects which the Committee desire to have brought to this exhibition. They, in fact, comprise specimens of all the productions of manual industry: such as

Fabrics of woollen, cotton, linen, and silk;

Iron, and all articles made of this material, whether wrought or cast;

Articles made of the precious metals, and of the compounds which imitate them; also of copper, lead, and all other metals;

Articles of pottery, glass, and porcelain—including artificial teeth;
Articles of stone and marble;
Cutlery; Arms of all kinds;
Paper, printing, engraving, binding, inks;
All productions of the laboratory;
Lamps, chandeliers, candelabra, and gas fixtures;
Furniture of wood, and all house utensils;
Musical instruments;
Leather and articles made of it;
Hats and Caps;
Clocks and watches;
Scales, balances, and philosophical instruments;
Tools and machinery of all kinds, &c. &c.

For the supply of these articles for the exhibition, the Institute must depend entirely upon the manufacturers, mechanics, and merchants; and the Committee appeal to them, with confidence, for the display, on this occasion, of the liberality and zeal which they have never heretofore failed to show.

It has been customary to append to this address, as made on similar occasions, a long list of subjects for which premiums would be awarded; but it is judged best, on the present occasion, to take a different and a still more liberal course, and to offer premiums for all such articles, in every department of the useful arts, as shall be judged worthy of the distinction. The premium offered is the medal of the Institute, which will be of gold or of silver, according to the value which the Committee shall attach to the subject of the award.

JOHN C. CRESSON,
WILLIAM H. KEATING,
ALEXANDER FERGUSON,
THOMAS FLETCHER,
ISAAC B. GARRIGUES,
ALEXANDER M'CLURG,
JOHN S. WARNER,
JOHN AGNEW,
WILLIAM H. CARR,
HENRY TROTH,
SAMUEL V. MERRICK,
ROBERT M. PATTERSON,

Committee on Premiums and Exhibitions.

Published by order of the Board of Managers.

JOHN WIEGAND, *Chairman.*

WILLIAM HAMILTON, *Actuary.*

Philadelphia, June 20, 1838.

REGULATIONS

Of the Tenth Exhibition of Domestic Manufactures, to be held in the City of Philadelphia, on the 5th, 6th, 7th, 8th and 9th days of November, 1838.

1. The Exhibition room will be prepared to receive the goods on Saturday, the 2nd of November, and opened for the admission of visiters on Tuesday, the 5th of November, at 10 o'clock, A. M.

2. All goods intended for competition must be deposited before 12 o'clock, (noon,) on Tuesday, the 5th of November.

3. The Judges shall be appointed on the 29th of September, and a list of them published in one or more newspapers.

4. To insure a perfect impartiality, the Managers of the Institute, the Committee on Premiums and Exhibitions, and all firms or partnerships in which a Manager, or a Member of the Committee on Premiums and Exhibitions, is interested, shall be excluded from competition; and no Committee shall award a premium or compliment to any of its members.

5. No premium shall be awarded for an article that has received one at any other public exhibition; and none shall receive a premium that is not equal in quality to the best articles of similar manufacture, presented at former exhibitions.

6. Proof of origin must be furnished, if required, for every specimen offered for exhibition.

7. All articles deposited must be accompanied by an invoice, stating the names and residences of the makers and depositors.

8. Arrangements will be made to exhibit to advantage any working models that may be sent in for exhibition, and the Managers respectfully invite contributions in this branch. Experience has shown the interest which the public take in them; and the Managers are impressed with a conviction that the display of them is calculated to convey useful information. A careful and competent superintendent will be provided.

9. The mornings of each day, until fifteen minutes before 10 o'clock, shall be appropriated to the Judges.

10. Neither owners nor depositors of goods shall be admitted to the exhibition room during the time appropriated to the Judges, except at the special request of the Judges of the articles owned or deposited by them.

// JOURNAL

OF THE

FRANKLIN INSTITUTE

OF THE

State of Pennsylvania,

AND

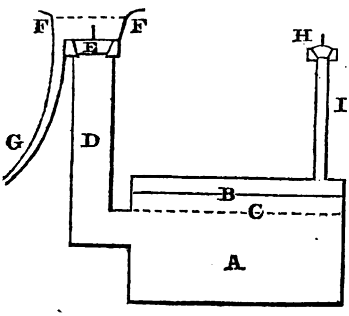
MECHANICS' REGISTER.

AUGUST, 1838.

Practical and Theoretical Mechanics and Chemistry.

FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

Suggestions relating to a mode of constructing Steam Boilers to guard against Explosions. By Erskine Hazard, C. E.



The numerous disasters which are occurring from the bursting of steam boilers, render it important that every plan should be suggested which has the least chance of remedying the evil. I therefore propose the following for the consideration of the Institute. A is a steam boiler, of which B is the high water line, and C the line below which the water is never intended to sink. D is a pipe introduced into the boiler, so that the upper edge of the entrance into it may be just at the lowest water line, and having the valve E like the common safety valve. From this construction it is evident that when steam forms in the boiler, a column of water will be forced up into the pipe D, the height of which, together with the weight of the valve E, must be adjusted so as to balance the highest pressure at which the engine is intended to work. Should the steam rise above this pressure, the water will raise the valve E, and escape into the receiver F F, from which it may be conducted through the pipe G, to a little water wheel, which will ring a bell near the engineer, and thus give him notice of the fact, when by raising the usual safety valve H, he may relieve the boiler by letting off the steam. Should the water sink too low in the boiler, the steam will immediately rush into the pipe D, and displace the column of water in it—the valve E, without this column of water, will not retain the steam, which will then escape, and by its noise give notice that there is a deficiency of water in the boiler. The pipe D may be of such large dimensions as to let off without danger the whole steam from the boiler, and thus effectually pre-

vent explosions. Small pipes, with valves, like D, may be introduced at different heights in the place of gauge cocks. The higher these pipes are carried, of course the less weight will be necessary in the valves, as the columns of water in them form a portion of the counter balance to the steam.

In sea vessels, the boilers should be divided, by wooden partitions, into small compartments, to prevent portions of the boiler being exposed dry to the fire even when there is sufficient water in the boiler, by the vessel being kept on an uneven keel by a long wave.

The above principle is applicable to boilers for heating water connected with our water works, where the pressure of the head is constantly upon them. Suppose A to be one of these boilers in a situation where the pressure of the water is equal to 30 lbs., with the pipe I, inserted at the highest point of the boiler. If this pipe were carried up about 60 feet, it would require no valve on top to close it, as the column of water would balance the pressure; but there are few situations where it would be convenient to carry a pipe so high. Make the pipe 20 feet high, and the column of water would equal 10 lbs., and by adding a valve of 20 lbs., you would resist the pressure of the water. But any steam forming in the boiler, would displace the column of water, and leave only the 20 lbs. pressure in the valve to resist the passage of the steam, which would be urged forward by the 30 lbs. pressure of the water works, and would continue to escape until the column of water again rose to the valve and equalized the pressure.

June 22d, 1838.

Physical Science.

TO THE COMMITTEE ON PUBLICATION OF THE FRANKLIN INSTITUTE.

Experiments on Spontaneous Evaporation. By JAMES P. ESPY.

On the 2nd April 1831, I hung up two porous earthen pots, which I kept constantly filled with water, one in the shade, and the other in the sun. The superficies of each was thirty square inches. I supplied these, from day to day, from two vials each containing 12 ounces of water, avoirdupois.

The pot in the sun evaporated,

April 2nd	to April 8th	12	oz.
8	17	12	"
17	27	12	"
27	May 5	12	"
May 5	" 12	12	"
12	" 18	12	"
18	" 24	12	"
24	" 29	12	"
29	June 4	12	"
June 4	" 10	12	"
10	" 19	12	"
19	" 26	12	"

The pot in the shade evaporated,

April 2nd	to April 10th	12	oz.
10	" 20	12	"
20	" 30	12	"
30	May 10	12	"
May 10	" 20	12	"
20	" 27	12	"
27	June 3	12	"
June 3rd	" 12	12	"
12	" 26	12	"
26	July 6	12	"
July 6	" 15	12	"
15	" 24	12	"
24	Aug. 3	12	"

On the same day, April 2nd, 1831, I also placed three tumblers of glass in the sun, one of them, in the open air, kept filled with water, and two sunk in the ground up to the rim, one of them was kept filled with water, the other with wet earth. From the 2nd of April to the 19th of May the tumbler in the open air had evaporated 21½ ounces, and each of those sunk in the earth 11 ounces, avoirdupois. On the 12th of June the sunk tumbler with water evaporated 21½ ounces, and on the 13th June, that is, one day longer, the tumbler with wet earth had evaporated 21⅓ ounces from the 2nd of April. The experiments with the two sunk tumblers were soon after discontinued in consequence of an accident—but the tumbler in the open air had evaporated 21½ ounces more on the 18th of June, and 21⅓ ounces more on the 24th of July. The area of the interior of the rim of each of these tumblers was 12 square inches.

It will be seen from these experiments, that about 2½ times as much evaporated from a square inch of surface of the porous pot in the sun as from the sunk tumblers in the sun, which can be accounted for from the readiness with which the vapour, as soon as formed, would be removed from the surface of the porous pot; for I have demonstrated since, by experiment, that if the film of vapour is not removed from the surface of a humid body, by the motion of the air, evaporation ceases; as air I find is not pervious to the vapour of water to any considerable extent.

From these experiments it may be calculated how much is evaporated from a humid surface of earth in a given time, at the season of the year in which the experiments were made, and unless I have made a mistake in a rough calculation, the reader will find that about 2.70 inches, in perpendicular depth were evaporated from each square inch of moist earth from the second of April to the 4th June, and from 2nd April to the 12th of June, 3.04 inches.

Wishing to know how much more rapidly evaporation goes on when the vapour is rapidly removed from the humid surface, I took two towels of 8000 square inches area each, or counting both surfaces 16000 square inches. I made these towels wet, and hung one of them up in a close room by two of its corners; and in the same room I swung the other towel about, continuing the experiment for 8 minutes, for two successive experiments.

Experiment 1st,	evaporation from	one at rest	119	grains.
"	"	one in motion	1153	"
Experiment 2nd.	"	one at rest	104	"
"	"	one in motion	1172	"

The temperature of the air at the beginning of first experiment was 74° and dew point 53.5°; at the end of 2nd experiment, temperature 74 and dew point 58.4.

A third experiment was made by blowing upon one of the towels with a fan, instead of agitating it in my hands, and the following is the result of the operation continued for eight minutes.

Experiment 3rd, towel at rest,	lost	107	grains.
" towel fanned	"	669	"

Temperature at beginning of experiment 75°, dew point 58°.

Temperature at the end of experiment 75.6, dew point 61°.

(Copied from my original minutes this 7th July, 1838, Philadelphia.)

Mechanics' Register.

LIST OF AMERICAN PATENTS WHICH ISSUED IN OCTOBER, 1837.
With Remarks and Exemplifications by the Editor.

312. For an improvement in the *Horse Power;* Henry Smith, Bethel, Miami county, Ohio, October 6.

There is but little of novelty in this power, the only things claimed being mere matters of arrangement, which may probably present some advantages. The horse power is to be a portable one, having an axle to receive wheels like cart wheels, and a tongue by which it may be drawn from place to place. A main horizontal wheel is to be turned by means of a lever, or sweep, which, by gearing, is to give motion to a line shaft, under the feet of the horse, as in numerous other machines. The claims are to "the method of hanging the master wheel upon a spindle which runs in a standard, and the rim of the wheel supported by rollers beneath; the method of constructing and fastening the arms of the master wheel by stirrups which support the lever to draw by, and the method of constructing the movable truck."

313. For a machine for *Boring and Mortising Wheel Hubs, and other articles;* James Tompkins, Conesville, Schoharie county, New York, October 6.

The claims made under this patent are very indefinite in their character, the principal dependance being upon the general arrangement and combination of the respective parts, which do not admit of ready verbal explanation.

314. For an improvement in the construction of *Clamps used by Shoemakers, Harness makers, and others,* for holding leather; Richard Evans, Mansfield, Warren county, New Jersey, October 6.

This clamp is represented in the drawing as made to be held between the knees, in the manner of those used by shoemakers, but it may be fixed upon a bench, in the manner of the harness-makers' clamp. Its peculiarity consists in the method of holding the jaws together, the claims being to "the modes described of closing, holding, and liberating, the clamps used by shoemakers and others, by having a notched piece of metal, or joint piece, fastened to one jaw, and sliding through the other, with a sliding catch and a thumb piece, operating substantially in the manner shown."

315. For an improvement in the *Railway Oven for Baking Bread, &c.;* Sewall Short, Nantucket, county of Nantucket, Massachusetts; patent dated September 6.

A brick oven is to be constructed, the upper part of which is a semicylindrical arch, within which there is a sheet iron oven, adapted to the arch, and having a flat bottom; this iron oven stands about three inches, on its top and sides, from the brick arch, the space forming a flue for the passage of flame and smoke; below the iron oven is a space also for the flame and heat passing from the grate containing the fuel, and thence under, and then around, the oven. The fuel is contained in a cylindrical grate, composed of iron bars, which is received in a recess in the brick work near the lower side of the oven, which recess opens into the space under the iron oven. The flame and smoke from the grate pass under the iron oven, then

up its far side, over the arch and down its near side, whence it escapes into a smoke pipe situated a little above the cylindrical grate; the cylindrical grate is made to revolve on axes at its ends.

The ends of the iron oven are closed, but there is a longitudinal opening in each, near the bottom, and nearly as wide as the oven; and through these openings the articles to be baked are passed into, and removed from, the oven. For this purpose a flat wire grating, mounted on a flat car, adapted to the openings, has the articles to be baked placed upon it, and is then run into the oven, there being at each end a frame, constituting a railway, upon which the wire grating, or flat car, is run in at one end, and out at the other, one car being removed, and another run in, as the baking is completed.

The claims made are to "the combination of the revolving grate, and the arrangement of the flues, with an oven constructed substantially as above described; and the combination of the railway and carriages with the ovens, as above described."

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316. For an improvement in the *Galley, or Cooking Stove, for Ships of War, &c.;* James Barron, Commodore U. S. Navy, city of Philadelphia, October 6.

The claims made are to "the manner of arranging the boilers in a ship's galley, or cooking stove, so that one of their sides shall be directly exposed to the action of the fire, as described. Also the placing of side ovens for baking, which receive their heat from the outer plates of the galley, as set forth. Likewise the movable grate to enable me to substitute wood for coal. Likewise the employment of a drawer, or drawers, in the manner and for the purpose explained; and also the construction and application of the canopy."

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317. For improvements in the *Hemp and Flax Dressing Machine;* William and Robert Brittain, Lambertsville, Hunterdon county, New Jersey, October 12.

This machine consists mainly of several successive pairs of rollers, placed one above the other, across a horizontal frame; these rollers have plates of iron along them, at suitable distances, formed into teeth, and are geared at their ends in such a way that the respective rows of teeth shall present themselves in the middle of the spaces of the corresponding rollers. The upper are borne down upon the lower rollers by adjustable springs. At the delivering end of the series of rollers one or two of the upper ones receive a quicker motion than the others, and those below them are to be simple rollers, without teeth, the object of which is to loosen and discharge the shives the more effectually from the hemp or flax.

"We do not claim the general arrangement of the rollers, or the insertion of metallic plates along them, these having been before used; but what we do claim as our invention in the above described machine, is the employment of one or more smooth rollers, the antagonists of which are furnished with metallic plates, and are so geared as to run with a different rate of speed, so that the material between them may be operated upon by a rubbing motion, as herein set forth. We also claim the use and application of the spring bars, for the uses and purposes herein set forth, and in the manner described."

318. For a *Press for Tobacco, and other substances*; James H. Washington, Baltimore, October 12.

The patentee says that the principle of his press "consists in the use of a right and left screw on one shaft, or stem, in combination with a cross head and piston peculiarly connected, by which two or more compressions are produced at one operation, and at each end of the machine, by the alternate action and reaction of the screw, or by a reverse action of the driving power." The claim made is to the peculiar manner of connecting the cross heads and pistons; that is to say, the mode of connecting the cross head to the piston, by which the piston can press on both sides; the cross heads being connected to the shanks of the pistons on the outside of the moulds, substantially as described."

It is not pretended that a right and left handed screw upon opposite ends of the same shaft, applied to a press, is new; but it is the adaptation of the press to its intended purpose of pressing tobacco, principally, which appears to be considered as constituting the claim. The screw is placed within a frame so as to operate horizontally, and by turning it the lumps at one end are pressed, while those at the other are relieved and renewed.

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319. For improvements in the *Machine for Measuring Fluids;* James Bogardus, City of New York, October 12.

The main object of this apparatus is its application as a gas meter, but its employment for the measuring of liquids is also contemplated. Its construction is made known by the aid of fourteen drawings; and without them, the claims would not afford any correct idea of the nature of the instrument.

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320. For improvements in the method of *Ascending and Descending Inclined Planes on Railroads;* Elisha F. Aldrick, city of New York, October 12.

We cannot discover any thing in the construction of the proposed apparatus, which will redeem it from the defects found in analogous contrivances which have preceded it. The claims made are to "the peculiar and various modes of constructing the raised rails, and wheels to fit the same. Also the method, or methods, of keeping the water level in the boilers of the locomotive. Likewise the mode of working the brakes, and the placing the cranks or connexions between the large and small wheels and the bearings, outside of the small wheels."

The main feature of the machine is old, and it is only to those peculiarities of arrangement made by the patentee, that any valid claim can exist. To ascend and descend inclined planes, rack rails are to be elevated on each side of the track, and upon these, cogwheels, or pinions, upon the wheel axles, either inside or outside of their bearings, are to run, the rack rails being elevated, not only to raise the driving wheels from the track, but to a sufficient height to keep the water in the boilers level, the small wheels still acting upon the main track. The plan of drawing the brakes against the wheels to check the motion, is, to force upon a lever which is affixed to a shaft, having a chain, or chains, attached to it, which draw up on the brakes when the shaft is turned.

The sustaining the load upon a rack rail, upon which pinions rest, may appear feasible to the inexperienced, but a little reflection will show to any one practically acquainted with mechanics, that the enormous friction upon

cogs thus loaded, and bottoming, would suffice to condemn the plan, were there no other objections to it. The mode proposed of causing the locomotive to take its place on the rack rail, as well as the other devices pointed out, do not bespeak the hand of an experienced engineer, and we are apprehensive that the proposed improvements will be found to be much more imaginary than real.

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321. For improvements in the *Machine for Cleaning Wool from Burs and other foreign substances;* Josiah Walcott, Jr., and Charles W. Brown, Roxbury, Norfolk county, Massachusetts, October 13.

The wool, with the burs in it, is to be fed by means of a feeding apron on to a card cylinder, like those used in the ordinary carding machine; when distributed upon this cylinder, as it passes down in its revolution, it encounters another cylinder, called a fly, from its rapid motion, and which is to clear out the burs from the wool. This fly cylinder has metallic plates about an inch wide, extending from end to end, at right angles to, or radially with, the cylinder. The outer edges of these plates are toothed, somewhat in the manner of a saw, the teeth coming nearly into contact with those of the card cylinders. The patentees say that "the fly in its rapid revolution in a contrary direction, strikes the wool with the comb plates, and knocks or combs the burs and other dirty substances entirely from it; and by this operation, it is most thoroughly cleansed without receiving the least damage in its fibre, or otherwise, nor do the cards receive any injury." "What we claim as our invention, and desire to secure by letters patent, is the combination of the fly or picking cylinder, with the porcupine or card cylinder, as above described."

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322. For *Removing the Bitterings from Salt Boilers*; David Dear, Salina, Onondago county, New York, October 18. (See Specification.)

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323. For an improvement in the *Cooking Stove;* Elijah Skinner, Sandwich, Strafford county, New Hampshire, October 18.

The manner of conducting the flues, and of connecting this stove with a brick hearth and fire place, constitute the principal points claimed. It does not, however, appear to possess any novel feature worthy of special notice, and we therefore leave it to take its proper standing in the stove family, according to its disposition and qualities, as these may be developed by experience.

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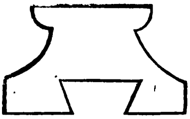
324. For *Constructing and Fastening the Iron Rails on the Timber of Railways*; Peter Henry Dreyer, city of New York, October 18.



The iron rail plate is to be made, with a dovetail groove on the under side, running its whole length, its cross section being as in the margin. These rails are to lay upon string pieces, to which they are to be fastened by iron bolts passing through the string pieces, beneath which they are to be key-wedged. The head of the bolt is dovetailed, to fit the groove, but by turning it one quarter round, the rail may be lifted, the flat side of the bolt clearing it of the groove. At their ends the rails are held by resting on plates secured to string pieces, and having dovetail projections upon them which pass into the ends of the rails. The claim is to "the dovetail grooved rails, dovetailed bolts and plates, and grooved

wedge plates, applied to the construction of railways; by which means, and the wedge key, the iron dovetail grooved rail is perfectly and most substantially secured on the string piece, or timber, of the railroad."

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325. For improved *Fire Apparatus for Cooking, and Warming Apartments*; Daniel Stephens, Kirtland, Geauga county, Ohio, October 18.

In this apparatus the fire is to be made in the middle of the room, in a fire place, over which there is an inverted funnel attached to a stove pipe, and suspended from the ceiling, the pipe leading to a chimney. There are several peculiar contrivances which are made the subjects of claim, but which it is not worth while to describe, as they are adapted to this apparatus particularly, and will share its fate, of which we are apprehensive that longevity will not form any part.

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326. For improvements in *Gun Carriages for Ships of War*; John Bubier, Marblehead, Massachusetts, October 20.

"The nature of my invention consists in providing the gun carriages with a centre slide and train wheel. The former for keeping the gun always in a line with the port, and giving more precision to the range of the shot by a steady and uniform recoil of the piece; and the latter to facilitate the movement, or training, of the gun upon the object."

The carriage is made, generally, in the usual manner, but it has grooved cleats fixed on the insides of each of its cheeks, resting on the forward and after axles, which grooves receive a slide that is tongued to fit them exactly. The slide has at its forward end, eye plates to receive a fighting bolt, which confines it, by a start, to the ship's sides; the start being placed in the quick work exactly in the centre of the port, and on a level with the slide, allowing it to play back and forth between the transum and the axles. The gun thus connected, never interferes with the port frame, but must always come out in the centre of the port. The train wheel, with its vertical shaft and screw, is placed at the rear of the gun carriage, the train wheel standing at right angles with the direction of the gun; the shaft and screw allowing the hind wheels, or trucks, to be raised from the deck, so that the weight may rest on the train wheel, and the gun be moved and trained at pleasure, without the use of crows, or handspikes, articles so destructive to the wood work of the vessel.

"What I claim as my invention, and desire to secure by letters patent, is the addition of the centre slide, and train wheel, to the gun carriages now in use on board of ships of war."

To nautical men it belongs to give a valid opinion of an invention like that above described, and possibly those who are competent to decide the question may urge some fatal objection to the plan. Of nautical matters we know nothing practically, and have not a right, therefore, to express with any confidence, the very favourable opinion which we entertain of Lieutenant Bubier's invention.

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327. For an improved *Door Spring for shutting Doors and Gates;* Ithiel S. Richardson, city of Boston, Massachusetts, October 20.

On the door frame, above the door, and towards its back edge, is affixed a frame which supports two wheels, or pulleys, grooved on their edges, and turning horizontally upon centre pins. A stud, or arm, is fixed on the door,

and projects above it, having a chain attached to it, the other end of which is fastened to the hindmost of the two pulleys, so that when the door is opened the chain will draw upon the pulley and cause it to turn; an excentric, or cam, is fixed on the axis of this pulley, and has attached to it one end of a second chain, the other end being fastened to a spiral spring by which it is drawn to it; the second pulley serves, by means of its groove, to conduct the chain from the cam to the spring. The claim is to "the application of a cam, or eccentric wheel, to a spring for shutting doors and gates, in the manner described, by which the power of the spring acting on the door, is decreased as the door opens; and which allows the spring to act with the greatest force when the door is nearest shut."

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328. For an improved mode of *Attaching Glass Knobs to Metallic Sockets;* Enoch and G. W. Robinson, city of Boston, Massachusetts, October 20.

The glass knobs for door handles, or other purposes, are to have necks which will fit into the metal socket to which they are to be attached. Around the neck is to be formed a hollow, or groove, to receive a portion of the melted metal by which the two are to be attached together. The neck and socket are to fit closely where they come together, but towards the lower part of the socket it must be enlarged to receive the metal which is to be poured in; a hole is to be drilled through the socket, opposite the groove in the knob. When thus prepared, the two are to be heated so as to adapt them to the receiving of the metal without danger to the glass; tin, or other fused metal, is then to be poured in at the hole drilled for that purpose. The claim is to "the fastening of the metal socket and the glass knobs, by means of melted metal introduced between them; and the adaptation of the forms of the knobs and sockets to effect that purpose, in any manner similar in principle to that described."

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329. For improvements in the mode of *Measuring, Draughting, and Cutting Garments;* Wm. W. Allen, city of Philadelphia, October 23.

The patentee makes eight distinct claims to his improved apparatus and mode of procedure. A rod, or standard, about six feet high, is to be erected upon a suitable platform, and upon this standard there are to be various vertical and horizontal slides, some of which are furnished with measuring tapes. This instrument operates in part like that described in our last number, p. 43, for measuring for pantaloons only, but this is applied to the difficult art of cutting coats; of its merits we give no opinion, the subject being one in which we might manifest much ignorance certainly and but little knowledge.

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330. For a *Brick Mould;* Benjamin N. Brown, city of Alexandria, D. C., October 23.

This mould is particularly adapted to be used with the machine for making bricks from dry clay, patented by Nathan Sawyer, on the 18th of April, 1835. The general form of the mould is the same with that described in the notice of Mr. Sawyer's patent, having the upper edges hollowed in the manner, and with the view, there set forth. In the present instance the mould is made double, consisting of one metallic box sliding within another, the object of which is to cause the clay to be condensed sufficiently in the

middle of the brick, by lessening the friction against the sides of the moulds; how this construction effects the purpose intended, may be more readily imagined than explained. The claim is to the double mould as described.

331. For improvements in the *Double Acting Force Pump;* Dudley L. Farnam, city of New York, October 23.

Claim. "What I claim as constituting my invention, are the combination and employment of two double acting cylinders in fire engines, ship's pumps, and others, where the raising and forcing of a large quantity is desired; the apparatus being arranged and constructed substantially in the way set forth, and combined with the valve seat plates, with their valves attached, as described, above and below the water chamber; whether the two cylinders, or only one be employed; and this mode of affixing the valve seats I claim, whether the said cylinders be double or single acting."

The valve seats are attached to the box, or chamber, on which the cylinders rest, by means of screw bolts, the removal of which liberates the valve plates, and gives immediate access to the valves for any purpose for which it may be required. The cylinders, it will be seen by the foregoing claim, are to be double acting, operating like the double acting steam engine, or rather like other double acting pumps, which are well known, but not previously used, it is believed, as connected or combined in the present apparatus.

332. For an improved *Composition of Matter to be used as Paint for Houses;* William Cox, Dayton, Montgomery county, Ohio, October 23.

This composition of matter is no doubt new, and it is about as heterogenous as could well have been desired; it is intended, it seems, to be used principally in painting brick houses; the following is the recipe:

For 33 gallons of paint, take one bushel of unslaked lime, one and a half gallons strong vinegar, five pounds of alum, two pounds of pearlash, five quarts of common salt, half a pound of salt petre, half a pound of borax; mix them in twenty-six gallons of hot water, and when dissolved it is ready for use. It is to be made of any desired colour by the addition of red lead, spanish brown, yellow ochre, or other pigment. The claim is to the combination of the above ingredients.

333. For a *Machine for making Bricks;* Gaylord D. Harper, Franklinville, Catteragus county, New York, October 23.

The claims made are to the combination and arrangement of the machine; to certain channels for conveying water to moisten the clay, and keep the bars wet; and to valves and apertures in the pistons. The issuing of the patent shows that the description of it was understood in the office when examined; it, however, is obscure, and the drawings not of a kind to lend the desired aid; we are not disposed to study the thing, as it would require more attention than it appears to merit, as it is not of very general interest.

334. For an improvement in the *Clasp and Lock for Mail Bags;* Henry C. Jones, Newark, New Jersey, October 23.

The claims are to the particular construction of a bolt for securing the clasp, in its combination therewith; to the arrangement of the springs, and spring guard; and to certain cams for raising the spring guard and throwing

back the bolt, as combined together. There appears to be too much complexity in the thing, and too much liability to derangement to render it suitable for mail bags; nor does it present any thing special, and worthy of particular notice.

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335. For an improved *Manufacture of Colouring Matter*; Henry Stephens, of St. Mary La Bonne, London, Great Britain, October 28.

This colouring matter consists principally of a solution of Prussian blue, and is extensively employed in the preparation of Stephens' blue writing ink. Since the date of the foregoing patent, it has been surrendered under an amended specification, a copy of which we intend to furnish in the next number of this journal.

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336. For an improvement in the *Circular Railway and Car*; James Rowe, Triana, Madison county, Alabama, October 28.

The patentee says that he has invented "a new and useful circular railway and car for transporting passengers, burdens, and for all other useful purposes to which said improvement may be applied."

To judge of the contents of a book by the title is no easy thing, and we believe that the same might be predicated of the patent before us. We are too much habituated, when about to travel in cars upon railways, to think of how great will be the distance to which we shall, in a few hours, be removed from the point of departure, to associate the same mode of conveyance with the idea of a mill-horse journey, round and round upon the same little circle; yet such is to be the progress in the present instance. This improved mode of conveying persons and things, is the old fashioned round-about adapted to run upon a circular rail of some eight or ten feet radius. The car is a circular platform, upon which seats are firmly fastened; which car, with those who have taken their seats upon it, may be whirled round at a rapid rate, by the aid of wheels and bands, or other similar mechanical appliances. These circulating vehicles are "designed for the exercise and pleasure grounds of cities, towns, villages, and all places of public resort." The great advantages of this mode of conveyance are distinctly set forth, under the following items. "*First.* The car is continuous round the whole circle, firmly united in all its parts, and driven from two opposite points, thus forming a balance of motion. *Second.* Accidents are prevented, from the impossibility of the car running off the track. *Third.* The car being driven by a chain or belt, consequently employs local, instead of locomotive power. *Fourth.* The car being continuous in a circle, will accommodate seats all around, and afford convenience for a great number of passengers to exercise and ride at the same time." The claims made include the means by which all these magnificent improvements are carried into effect.

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337. For improvements in the *Force and Suction Pump;* Abraham Kasslar, Canajoharie, Montgomery county, New York, October 28.

This is a pump with two cylinders, the pistons being worked by the same lever. We cannot find a single thing about it which can justly be denominated an improvement, the only novelty being in the particular manner of putting certain parts together, which, however, does not offer any thing worthy of imitation, and, of course not worth describing. It presents one of those cases in which a patent is granted upon a doubt of the propriety of refusing it.

338. For an improvement in *Book Binding;* William Hancock, city of London, Kingdom of Great Britain, October 28. (See Specification.)

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339. For a *Worm Destroying Medicine;* John J. Oellig, Waynesborough, Franklin county, Pennsylvania, October 28.

"Preparation of the compound sufficient to fill an ounce phial:—Oil of tansey, two drops; tincture of foxglove, twelve drops; oil of anise-seed, ten drops; oil of worm seed, one scruple; compound tincture of male fern, fifteen drops; castor oil, one ounce. The above articles to be well compounded together."

"A teaspoonful of this medicine must be given to a child every two hours, till it operates; to an adult, a phial morning and evening." The claim is to "the before described compound."

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340. For *Tonic and Aperient Alterative Pills;* John J. Oellig, Waynesborough, Franklin county, Pennsylvania, October 28.

"The following is the compound for one hundred and fifty pills:—Crab apple root bark, one drachm and a half; rhubarb, two drachms; extract of horehound, twenty grains; sal. soda, two scruples; and castile soap sufficient to make the above into a mass for pills." The claim is to "the above described compound medicine."

There are few questions of greater difficulty before the patent office than those arising upon applications for patents for medicines. Many are refused upon the ground that they offer nothing really new, and we are of opinion that the foregoing might fairly have been denied upon this ground; but the office has not the power to refuse, or to grant a patent at the discretion of the Commissioner; the law prescribes the principles upon which he is to act, and it is his duty to construe it in a manner the most favourable to the applicant; it becomes his duty to grant a patent, in all doubtful cases, and to leave the question of its validity to the courts of law. We are of opinion that a legal provision excluding medicines from the list of patentable articles, would be a blessing to the community. Such patents are not obtained by the regular scientific practitioner; he, should his experience point out the superior efficacy of any particular formula, publishes it in the journals devoted to his art, for the information of his practicing brethren, and the advantage of suffering humanity. We do not intend to stigmatize every one who obtains a patent for a medicine, by applying to him the title of quack; there may be cases in which this would not be just, but such cases are few and far between.

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341. For an improved *Steam Vessel for Cooking;* John Morris, Derby, New Haven county, Connecticut, October 28.

The patentee says that his "invention consists in forming a steam chamber with a double case, so as to admit a column of air between them; and in placing the food to be cooked within the inner chamber which receives the steam direct from the boiling water; and being surrounded with a column of hot air, the steam is prevented from condensing; and by arming this chamber with a safety valve, of peculiar and simple construction, all danger of explosion is prevented." The apparatus is clearly described and represented, and the claim made is to "the manner of constructing the ma-

chine, or vessel, for cooking by steam, and the several parts thereof combined as specified and described."

342. For an improvement in the mode of *Constructing Hubs for the Wheels of Carriages;* Howard Delano, Skaneateles, Onondaga county, New York, October 28.

This hub is to be of cast iron, in one piece, having suitable sockets, or mortices, cast in it, to receive the spokes of the wheel. To admit the axle it is to be bored in from its inner towards its front end, but leaving the metal solid in front; as the round part of the axle is to enter the hub at its inner end, and is to be confined in place by a screw cap, and its appendages. A screw is cut on the inner end of the hub, to receive the screw cap; and a groove is turned in the axle, just back of the hub, to receive a divided metallic washer against which the screw cap, when secured on to the hub, is to bear. There is a leather washer also, inserted with the metallic one, to prevent the oil from escaping which is to lubricate the hub; between this and the axle there is a chamber, or space, to hold a portion of oil, which is supplied to the chamber through a hole drilled into it for that purpose, which hole is furnished with a screw plug, or stopper.

"I claim as my invention, the mode or means by which cast iron hubs, and the wheels of carriages are attached, and held securely, by the insertion of joint washers in a groove on the arms of the axletree, and the screw cap or band embracing within it the washers, and screwing on to the inner end of the hub, in the manner described."

SPECIFICATIONS OF AMERICAN PATENTS.

Specification of a patent for improvements in the process of separating and removing the bitterings from the kettles or boilers used in the manufacturing of salt; granted to DAVID DEAR, *Salina, Onondaga county, New York, October 18th,* 1837.

To all whom it may concern, be it known that I, David Dear, of the town of Salina, county of Onondaga, and State of New York, have invented a new and improved mode of separating the bitterings from, and cleaning the same from salt kettles, or boilers, of any description used in the manufacture of salt, and I do hereby declare that the following is a full and exact description thereof. The nature of my invention consists in using any of the properties of ashes, such as ley, kelp, or potash, in such quantity as shall be necessary to slack, soften, or remove the bitterings from the kettles, or boilers of any description used in the manufacture of salt, without cooling down the fire underneath the kettles, or boilers of any description, in which salt is, or may be, manufactured.

To enable others to make use of, and use, my invention, I will proceed to describe the manner in which I clean the kettles, or boilers, of the bittering collected on the inside of them by boiling salt therein. In the first place, as the kettles, or boilers, of the salt block are in full operation in making salt, I commence with any two, or more, of the kettles, or boilers, in the block, and dip the brine out of them. I then fill the kettles, or boilers, so emptied, with ley, or with fresh water, and dissolve kelp, or potash,

therein, or such other alkali as shall have the same effect, in sufficient quantity to make a strong ley thereof, which ley when heated to a boiling state has such an effect upon the bitterings adhering to the kettles, or boilers, as to either slack, or soften, them to such a degree, that they may be removed from, and taken out of the kettle, or boiler, with a ladle made for the purpose; after removing the bitterings from the kettle, or boiler, proceed to dip and clean the ley from the same, and pour it into the next empty kettle, or boiler, and then fill up the first kettle, or boiler, so cleaned of its bitterings and ley, with brine from the third kettle, or boiler; proceed in the same manner until the kettles, or boilers, in the salt block, are all cleaned of their bitterings. If the ley should become too weak by being too much used, strengthen it by dissolving more alkali therein.

David Dear.

Specification of a patent for improvements in Book Binding; granted to William Hancock, *of the city of London, in the Kingdom of Great Britain, October 23rd,* 1837.

I, William Hancock, do hereby declare that the nature of my "improvements in book binding" consists in attaching or binding the leaves of books together by applying Caoutchouc, or solutions of Caoutchouc, or Caoutchouc partly in the sheet state and partly in a state of solution, in such manner to the leaves of the said books that sawing and sewing the same is rendered unnecessary, and books so bound are made to open perfectly flat, or more nearly so than books bound by any other method heretofore in use. And also in applying Caoutchouc in the said states and in such manner to the backs of the sheets of books, after they have been sewn or stitched in the usual way as greatly to improve the same in point of solidity and elasticity. And the manner in which the same is performed I shall now proceed to describe. Having folded the sheets of which the book is to consist according to the determined size thereof, whether folio, quarto, octavo or any other form, and assorted, made up, beat, and pressed, the same as is ordinarily done preparatory to sewing by the common method, I place them in a cutting press between two cutting boards, with just so much of the backs of the sheets projecting from the upper edges of the boards that on cutting away the same, which I next proceed to do with the ploughing knife, the leaves of each sheet are separated and detached at the back from one another. The surface left by this ploughing process being commonly smooth, I make it a little rough, either by rubbing it with sand paper or by rasping it with a book-binder's grater or rake. Sometimes I also avoid altogether such smoothness of surface by employing instead of the ordinary ploughing knife, a tooth plane with a very fine serrated edge. Immediately after cutting and before shifting the mass of leaves from the cutting press, I apply to the back surface so cut and prepared, a coating of solution of Caoutchouc, obtained by dissolving sheet Caoutchouc in pure spirits of turpentine, in the proportions of a pound of the former to a gallon of the latter, or thereabouts. When the said coating is dry, I add a second coating of the same solution and when that also has dried I lay on a strip or band of Caoutchouc cloth, which cloth I make by spreading a solution of Caoutchouc obtained in the manner hereinbefore mentioned, upon linen, woollen, cotton, silk, or any other flexible material, adapted to the purpose of book-

binding. To cause this strip or band to adhere firmly to the back, I apply it in a warm, sticky state, and then rub or press it on with the hand or a roller. The mass of leaves of which the book consists, will now be found so firmly cemented together, that they may be removed from the cutting press and the boarding and finishing proceeded with in the ordinary way. Instead of ploughing away the whole of the backs of the sheets as aforesaid, two or three or any greater number of broad grooves may be cut therein at equal distances, and just deep enough to go through all the folds that may be one within the other, and having coated the whole, the plain as well as grooved parts, twice over with a solution of Caoutchouc, as before directed, I insert in the said grooves, cross bands of the Caoutchouc cloth made as aforesaid, the ends of which cross bands, I attach to the boards or covers of the books in the usual manner. Instead of employing a back consisting of cloth or some other flexible material coated with a solution of Caoutchouc, I sometimes find it convenient to make use of the sheet Caoutchouc in its undissolved state, superadding thereto a coating of the solution. I find also that in the case of books in folio sheets and of books in quarto, when made up in half sheets, and of books in octavo when made up in quarter sheets, and generally of all leaves when in a simply duplicate state with a back of one fold, such sheets and leaves may be very securely cemented and bound together, without any cutting or ploughing at the back, by applying Caoutchouc in any of the states or modes aforesaid to the backs of such sheets or leaves after the same have been assorted, made up, beat, and pressed, as aforesaid, for the purpose of binding. When a book is composed of leaves originally single, I plough and rasp them in the manner before described; if such leaves are of large dimensions, such as plates or maps, I attach to the back edge of each, by means of a solution of Caoutchouc, obtained as aforesaid, a strip of cotton or other suitable material of such size that it overlaps the leaf to the extent of about a quarter of an inch on each side, and then make up and bind together the sheets so individually prepared in the manner hereinbefore directed for binding books of other descriptions. I find also, that when books are sewn or stitched in the usual way, the solidity and elasticity of the backs thereof are greatly improved by applying thereto Caoutchouc, or solutions of Caoutchouc, in the manner hereinbefore directed with respect to books consisting of quarto, or other sheets with backs of only one fold.

And having now described the nature of my said invented improvements in book-binding, and the manner in which the same are to be performed, I declare that I do not claim as new or of my invention, the employment of Caoutchouc in book-binding, but that I claim as new and of my invention the employment of Caoutchouc in book-binding in the manner and modes hereinbefore set forth, so that the sheets or leaves of books are in some cases bound together without sawing and sewing, and books so bound, open perfectly flat or more nearly so than books bound by any other method heretofore in use. And in other cases when books are sewn or stitched in the usual way, the backs thereof are greatly improved in point of solidity and elasticity. And I claim as comprehended under my Patent, any and every other mode or manner of employing Caoutchouc to produce the new and useful effects aforesaid which shall involve no material departure from the manner hereinbefore specified.

WILLIAM HANCOCK.

Progress of Practical and Theoretical Mechanics and Chemistry.

Report of Magnetical Experiments, tried on board an iron steam vessel by order of the Right Honorable the Lords Commissioners of the Admiralty. By Edward J. Johnson, Esq., commander, R.N., F.R.S.

The very extensive use of iron in the construction of modern vessels, and still more recently, the formation of steam vessels entirely of that material, has rendered the compass, notwithstanding its successive improvements, little more than a piece of useless lumber; or, more properly speaking, it is become unworthy of confidence; and, consequently, where it is trusted, a deceptive and frivolous apparatus. Indeed, the compass in its rudest form, even the Chinese, or the early European, with ships built as ships were then built, was worthy of far greater confidence than the most improved compass is on board a vessel of modern construction. There is no doubt, indeed, that were the weather always clear, the compass might be advantageously dispensed with in maritime affairs; but, as during not only days but weeks of the most tempestuous weather, when not a single lunar observation can be taken, nor any kind of complete observation made, the vessel is driving about amongst known or unknown dangers, it cannot but be viewed as a most perilous condition, when the direction itself upon which she is sailing, is a matter of almost total uncertainty. If indeed, she be out at sea, and far from land, she is safe, provided her strength be sufficient to ride out the storm: but every year, we are well assured that numerous cases of heart-rending scenes of wreck and desolation would be escaped had they the power to ascertain the course upon which they were bearing. This, however, is utterly impossible, as ships are now built, by the use of the compass simply.

Mr. Barlow's correcting-plate is, on this account, one of the greatest boons conferred on modern navigation. This term, as most of our readers are aware, is something of a misnomer; since the plate, instead of correcting the error produced by the iron of the ships, *doubles* it; but we would not quarrel with names—as it is with things we have to deal. It enables us, by a very simple numerical process, to ascertain, approximately, the effect of the iron of the ship upon the direction of the needle, and to make allowance for it in our reckoning.

It is strange, however, to witness the apathy with which the reckless seamen, in time of security, look upon the possible danger of a future, and not remote, period. A single hour in port would enable the master to find the effect of his iron with considerable precision: and yet this single hour he thinks it too much to give to his own and his crew's future safety. Strange infatuation!—but infatuation almost always follows close upon the heels of familiarity with danger.

We do not require to be told that Barlow's plate is not perfect. This we are as fully aware of as any one: and we do not urge implicit reliance upon it, in any sense of the word, under all possible circumstances. Still, if it enable us under all conditions to ascertain the amount of the effect of iron *approximately*, and often within very narrow limits, surely we must be determined upon rushing into danger, if we do not avail ourselves of it to the degree in which it can assist us. We are utterly opposed to the use of the compass at all, in those cases where it can be dispensed with: but as cases so perpetually occur where it is our *only* guide, and those cases pre-

cisely those of the greatest danger, it is surely worthy of the most serious attention, from every practical navigator, as well as from men of science.*

At the period when Mr. Barlow proposed his plan of the correcting-plate, he had in especial view the effect of the immense masses of iron which the guns on board men of war contained. Of course, *cæteris paribus*, the same circumstances would occur on board the smaller vessels in the merchant service, and require correction accordingly. The recent introduction of iron steamers has, however, given a new and important interest to this contrivance. These are chiefly designed for passengers, and, in some cases, more than five hundred are crowded on board a single steamer. We do not indeed, just now, know to what extent the iron steamers have been introduced: but as they have many advantages, in respect to security and convenience, over those of wood, they will most likely supersede them entirely, *provided they can be rendered as safe for the purposes of navigation by the compass*,—circumstances giving rise which must inevitably occur in all voyages of any considerable extent. The inquiry into this possibility, it was the main object of Captain Johnson's experiments satisfactorily to answer; and we proceed to give a brief analysis of them.

The Dublin Steam Navigation Company placed at the disposal of the Lords Commissioners of the Admiralty a fine new vessel; built entirely of iron, the *Garryowen*, for the purpose of investigating the effect of the vessel upon the indications of the compass, in any way that their Lordships may think proper.† They appointed Captain Johnson to make the requisite experiments; and he repaired in her to the port of Limerick, in the autumn of last year, to carry them into execution. The results have been printed for the Royal Society's Transactions; but they are not yet published. We avail ourselves, however, of a copy of the Memorial, with which we have

*In an early number we shall give a thorough examination of the principles of Barlow's correcting plate; and endeavor to show the degree of theoretical evidence combined with experiment, this method has for its foundation.

†Weight of iron.—Total weight of iron, including hull, machinery, anchors, cables, &c. . . . 180 tons.

Weight of iron in hull		95 tons.
Do.	engines	40 "
Do.	shafts and wheels	12 "
Do.	boilers	30 "
Do.	chimney	1 10
Do.	anchors and cables	1 10

Stem, 14 feet long × 4 feet wide.
Beam, 4 in. deep, 4 in. wide, bound with iron plates.
All the iron used in the hull and boilers is malleable.

Dimensions of Vessel, &c.

Length on deck 130 feet; beam 21 ft. 6 in.
Do. keel, 122 3; depth 11 ft. 0 in.
38 double frames a-midships, of angle iron 2 in. wide × 3 deep × ½ in.

17 single frames forward, of	3 × 3 × 5-8
22 do. aft,	3 × 3 × 5.16
Diameter of chimney	3 feet.
Height of ditto	28

Draught of water, forward 5 ft. 3 in. aft 5 ft.

Two Engines=85 horse power.

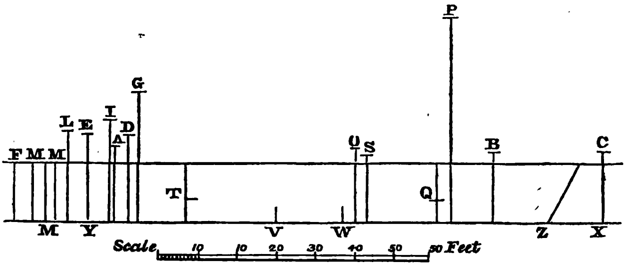
Diameter of cylinder	3 ft. 0 in.
Diameter of wheel	15 ft 6 in.

Engine makes 27 strokes per minute.

been favoured, to lay before our readers a succinct account of them, and a few reflections on the results they bring to light.

There being no wet dock in the port of Limerick in which the *Garryowen* could be conveniently swung round, to make the observations in different azimuths, point by point, he fixed upon a position in Tarbert Bay, well adapted to his purpose. His operations were commenced on the 19th of October, and continued, as circumstances permitted, till the 18th of November.

In order, however, to show the positions in the vessel at which the several observations were made, the following diagram is given. The line Y Z is the keel, Y being the stern, and Z the stem; V is the place of the chimney, and W the axle of the paddle-wheel. The positions of the other points will be easily judged of, from the accompanying scale and table: and these designate the positions of the compasses named by the several letters themselves.



A Quarter deck, 5 feet 9 inches above the deck.
B Forecastle, 5 feet 11 inches above the deck.
C Bowsprit, on glass-legs.
D On the fore-part of the temporary poop, above deck 8 feet $5\frac{3}{4}$ inches.
E On the after-part of the temporary poop, 8 feet 5 inches from the deck.
F On a stage level with the taffrail.
G On a plank 4 feet below the main-gaff end, and above deck, 20 feet 5 inches.
I On the centre of the temporary poop, above deck 13 feet $4\frac{1}{2}$ inches.
L On the poop projecting over the stern.
M M M Three stations on the stage over the stern, level with the taffrail.
O Between the paddle-boxes.
P Two-thirds up the fore-topmast, above the deck 40 feet 2 inches.
Q (On glass legs) in the fore-hold.
S In the iron sphere a-midships, above deck 7 feet.
T In the cabin.

All made in the middle of the vessel, 9 feet 11 inches from each side.

After the preliminary operations of fixing stations, &c. were gone through, Captain Johnson saw it to be necessary to put all the iron which the vessel carried, in the places which it usually occupied during the voyage, such as the anchors, cables, &c. He then tried the effect of the whole in that direction of the vessel where, in the generality of cases, the deviation had been found to be a maximum, so as in some degree to guide him in the se-

lection of a place for the principal observations,—or that, which his orders especially directed, in which to place a steering compass, and where the effect of the plate may be successfully tried.

With this view, the vessel's head was warped to the true magnetic east, and the deviations at several parts of her ascertained:

At B, the deviation of the marked end of the needle = 16° E.
Near the centre, and before the funnel, it was = 26° 20′ E.
At A, when the boats' davits were out = 11° 40′ E.
. . were on board = 6° 20′ E.

The preceding facts, showing the influence of iron in the vicinity of the compass, may be worthy of the attention of the practical navigator, for they show, at a position not far from the binnacle, a difference of deviation of no less than 5° 20′ under the mere circumstance of swinging the quarter boats' davits in board, from their usual position where boats are hoisted up, to that place in which they would be secured in stormy weather at sea.

Though the principal object of these experiments was to determine the best position for a steering compass on board the iron steamer (which induced him to select A and B as especial places of observation,) Captain Johnson tried the effect of the vessel at all the places in the table given above. We need not follow him through all the details of the precautions which he used for insuring the elimination of all foreign influences of an accidental kind, nor of those for securing good observations. A brief statement of the positions is, however, necessary.

A fixed station X* was selected on the south-west side of Tarbert Bay, a mile distant from the vessel, from which the cone of the mountain Dicomede, in the county of Clare, distant about nineteen miles, was distinctly visible. The bearing of it was determined by the compass which was afterwards used at station A on board the vessel; the magnetic meridian was also then determined by this compass, and a distant object in that meridian on land, was noted. The theodolite, in the succeeding observations, was placed at X in the same position as the compass, thereby rendering the simultaneous observations at A and X virtually identical with those which would have been determined by one compass only. The vessel was then taut moored in the line between the station X and the cone of the mountain,—in the line of direction of which was also a remarkable heap of stones on Kilkerran Point,—so that the vertical wire of the theodolite at X bisected these objects and the instrument on the forecastle of the vessel.

The bearings of the cone of the mountain from the positions A and B as well as the simultaneous bearings between A and X, were observed when the vessel's head was at each point, and from these bearings between A and X the deviation of the compass produced by local attraction was deduced. Of course we cannot give the tables entire, and we mention the circumstances under which the observations were made, to show that every requisite care was used to ensure correct results. We are, however, still under the necessity of giving one, referring our readers to the paper itself for the others. This contains the simultaneous observations made with nine compasses in different parts of the vessel, the bell being struck as a signal for observation. *See Table.*

*No figure is given to these descriptions; nor is any necessary, as the reader can easily sketch it from the verbal statements.

Date.	True magnetic direction of vessel's head.	Direction of vessel's head by compass F.	Deviation at F.	Direction of vessel's head by T.	Deviation at T.	Direction of vessel's head by G.	Deviation at G.	Direction of vessel's head by A.	Deviation at A.	Direction of vessel's head by O.	Deviation at O.
		° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′
Nov. 5.	North.	North.	0 0	N. 26 0 E.	26 0	N. 1 0 E.	1 0	N. 8 20 E.	8 20	N. 16 30 E.	16 30
Therm. 52° 1.	N. E.	N. 33 0 E.	12 0	N. 74 30 E.	29 30	N. 45 0 E.	0 0	N. 55 0 E.	10 0	N. 72 0 E.	27 0
Barom. 29.8.	East.	N. 67 0 E.	23 0	S. 59 30 E.	30 30	East.	0 0	N. 80 40 E.	9 20	S. 66 0 E.	23 0
	S. E.	S. 64 30 E.	19 30	S. 30 15 E.	14 45	S. 45 0 E.	0 0	S. 39 30 E.	5 30	S. 35 0 E.	10 0
Nov. 4.	South.	S. 1 0 E.	1 0	S. 10 30 E.	10 30	S. 1 0 E.	1 0	S. 1 0 E.	1 0	S. 5 0 E.	5 0
Therm. 56°	S. W.	S. 65 0 W.	20 0	S. 8 30 W.	36 30	S. 45 0 W.	0 0	S. 33 0 W.	12 0	S. 26 0 W.	19 0
Barom. 29.7	West.	N. 66 30 W.	23 30	S. 35 30 W.	54 30	N. 85 0 W.	5 0	S. 80 0 W.	10 0	S. 63 15 W	26 45
	N. W.	N. 32 0 W.	13 0	N. 30 0 W.	15 0	N. 40 0 W.	5 0	N. 38 0 W.	7 0	N. 64 0 W.	19 0
		Direction of vessel's head by Q	Deviation at Q.	P.	at P.	B.	at B	C.	at C.		
Nov. 5.	North.	N. 18° 0′ E.	18 0	N. 1 24 E.	1 24	N. 9 40 E.	9 40	N. 1 24 E.	1 24		
Therm. 52° 1.	N. E.	N. 56 15 E.	11 15	N. 47 48 E.	2 48	N. 56 0 E.	11 0	N. 43 36 E.	1 24		
Barom. 29.8.	East.	S. 73 8 E.	16 52	S. 81 33 E.	8 27	N. 82 30 E.	7 30	East.	0 0		
	S. E.	S. 36 33 E.	8 27	S. 42 12 E.	2 48	S. 41 0 E.	4 0	S. 42 12 E.	2 48		
Nov. 4.	South.	S. 9 51 E.	9 51	South.	0 0	S. 5 0 E.	5 0	South.	0 0		
Therm. 56°.	S. W.	S. 14 3 W.	30 57	S. 41 30 W.	3 30	S. 27 30 W.	17 30	S. 45 0 W.	0 0		
Barom. 29.7.	West.	S. 59 3 W.	30 57	S 84 23 W.	5 37	S. 73 30 W.	16 30	N. 86 30 W.	3 30		
	N. W.	N. 32 21 W.	12 39	N. 47 48 W.	2 48	N. 40 30 W.	4 30	N. 36 33 W.	8 27		

In looking at this table, it is impossible not to be struck with the immediate effect of the iron composing the vessel and her works, upon the indications of the needle, as the ship's head is turned into different azimuths, being in some cases even more than five points. It is also evident, that in different vessels this will very materially vary, and that little assistance can be derived from experiments made in one vessel towards guiding us in judging of the influence of the iron in another of a different, or even of a similar construction,—so far as form and disposition of metal are concerned in rendering them similar. To this, however, we shall speak presently. It is true that at G, C, P, the influence is much less than at any of the other positions where the observations were made; but as these are positions at which, in actual navigation, the observations could not be conveniently made, there can be no inference in favour of the employment of iron steamers deduced from these,—however interesting they may be in reference to some questions concerning the extent of the influence of iron on the magnet, and upon the law of its decrease of force as the distance is increased.

The result of these observations, as well as his first already mentioned, was conclusive to Captain Johnson's mind, that for the purposes of navigation, his observations should be chiefly confined to the positions A and B. Of two series of such observations, the discrepancies are unaccountably great, and especially so, seeing that every possible precaution was taken to secure a sameness of circumstances under which to make the observations. Captain Johnson was not, however, so much surprised at this circumstance as we should have expected; as he had remarked that the "embarrassment in the movement of the needles" after the first series, in some degree prepared him to expect it,—or, in other words, the difference in the magnetic state of the needles themselves, induced by the first series, was so great, that their indications would be materially altered in the second. This we can easily, to a certain degree, but not to the amount which these experiments indicate, conceive; the directive force of the needle may be increased or diminished by induction we admit, and then the power of the iron remaining the same, its influence would be accordingly less or greater upon the position of the needle when out of the magnetic meridian: but still that pure iron should induce *so much permanent change* in the magnetic state of the hard steel of the needle is to us inconceivable. All experiments go to prove the reverse of this. Captain Johnson's subsequent experiments prove the reverse of this, too; for they actually show that the vessel herself was a *permanent magnet*, and not a magnet by induction, as cast-iron is generally found to be. Now the needle itself could produce no sensible effect upon the state of the larger magnet; and hence her power upon the needle would be sensibly the same in both series of experiments, whilst that of the needle to resist her influence may be varied in a great degree. Captain Johnson is led to attribute the different effects (in another series of experiments which he afterwards made with the same needles) of the head and stern of the vessel to the needles placed upon the quay, to the different disposition of the quantity of iron in those two parts of her; but at the distances at which he observed these deflections, we cannot account for it on these principles, especially keeping in view the very minute influence recorded to have been exercised upon the needles at G, C, and P, in his former experiments, in the table which we have copied above.

The intensity of the magnetic force in the needle was greatly altered by the iron of the vessel; the dip was also very greatly altered. All this, of

course, we should expect; but we wish the *intensity* of the needles had been observed on shore both before and after the experiments were made on board; and as nearly as possible under the same circumstances. This, we consider an unfortunate omission; but we do not blame Captain Johnson for it. The time of the year was unfavourable, affording so few days fitted for observation, and the period allotted to the whole series was much too short under such unfavourable circumstances. If we are not mistaken, other observation, too, were made which are not here published; and, possibly, when they are made public, they may throw some further light upon the phenomena. However, in this respect, we are not able really to say what those observations were, nor whether they at all bear upon this question. If they do, it was a mistake to withhold them from the scientific public on the present occasion.

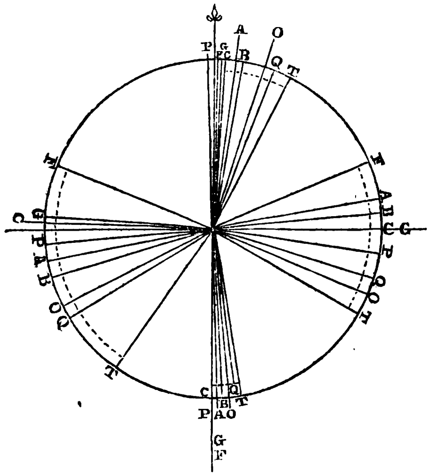
The two following diagrams exhibit visually the several circumstances of these experiments; and require scarcely any description.

Diagram I, represents the deviation of several compasses, when placed in different parts of the vessel, when her head was in the true magnetic direction of the cardinal points of the compass.

Diagram II, represents the comparative dip of the magnetic needle, on Tarbert Islands and that observed at three positions on board the *Garryowen*, in Tarbert Bay, when the vessel's head was to the true magnetic north and south.

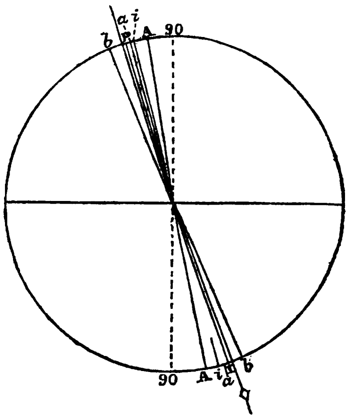
Diagram I.

True Magnetic North.



Magnetic South.

Diagram II.



Dip on shore.

A, I. Dip observed at those positions with the vessel's head to the north.

a, i, b. Dip with vessel's head to the south.

When we consider the great number of parts of which a vessel is composed, and the processes by which those parts are formed, we can hardly be justified in considering the vessel as other than *an immense magazine of permanent magnets* fastened together. Were they all, indeed, so placed in building her, that their axis may be parallel, we may be better able to form

some general idea of the magnetic resultant, (so to speak,) and to guess at the intensity and directive force exerted by the whole system; but, even then, the difficulties, in the present state of magnetic knowledge, would be absolutely insurmountable. When, however, we consider the effect of a single and slight stroke with a hammer upon a permanent magnetic bar—the total disregard paid in building the vessel as to the magnetic state of her materials—the utter impossibility of ascertaining it after they are put together, or to alter it, definitely, in any one of the pieces—when we consider that *malleable* iron can alone be employed, and that all these difficulties stand in the way of even placing the component parts of the compound magnet parallel to one another, we say, we are compelled to affirm, that the real magnetic state of an iron ship is incapable of being ascertained by any series of experiments whatever. Captain Johnson's experiments verify, but do not in our minds strengthen, our convictions on this head. They were formed, *à priori*; and from the view which in common with all scientific men, we had before taken of the necessary consequences of the most familiar phenomena, as well as of the diversified experiments of a more refined class carried on by the most eminent philosophers for many years. Instead, therefore, of considering the steamer as a single permanent magnet, we ought to consider her as a vast apparatus of united magnets, distributed perfectly at random; and their relative positions and intensities altogether incapable of estimation. Are we not justified, then, in saying, as we have said above, that we are incapable of judging from a series of experiments made on board one vessel, what the effect of one (so far as general form and disposition of material are concerned) similarly built in all respects may be? Surely, we are.

Let us, however, even waive this objection. Have we not seen that on board the *same vessel*, on two different days not very remote from each other, the deviation of the *same needles* was very different when all circumstances were alike, except that the magnetic states of the needles were *themselves changed* by the first series of observations? We do not, indeed, know where the needles were placed during the intermediate period,—whether ashore or on board. If on shore, the influence of the short period during which the first observation was made, is only indicative of the intense action of the compound magnet, which could, in so short a time, produce such a permanent change in the needles: if on board they were probably kept in the positions of observation, and if so, it proves how dangerous it is to trust to the *same compass, from one day to another.* The compass with which we leave port is a different compass after a single hour's voyage, and after three or four days, has been "deteriorated" to such a degree as to be unworthy of the slightest confidence.

When we look at the matter in this light, we need not inform our readers that we look also upon all attempts at the correction of the local attraction, by means of Barlow's plate, as utterly useless *on board an iron steamer.* Upon this subject, however, as we said before, we intend to speak more fully in a future number: it is sufficient to say here, that Captain Johnson appears to have made but few experiments with it, owing to the "unfavourable state of the weather." It is very true that unfavourable weather is disadvantageous for good experiments for mathematical investigations of the *laws* which reign through physical phenomena; but we do really think, that, from the circumstance of the knowledge itself being only required in bad weather, the present was an advantageous opportunity thrown away; inasmuch as the amount of discrepancy to be expected in times when the com-

pass is our only trust, is in a practical point of view, infinitely more important than a knowledge, however accurate, of the laws which prevail when the compass is never recurred to by a properly educated sailor. It is surely of greater consequence to know how far we may *safely* trust our instruments, at the time when they are our *only* trust, than to ascertain their laws in a state of comparative repose, and when they are altogether unnecessary to our safety.

Finally, we feel it our duty to our readers and to the public, to express emphatically, our conviction of the extreme danger of this class of vessels, for the purposes of navigation by means of the compass,—or, in other words, for venturing out of the mouth of a river. It is neither our wish, nor our interest, to discourage the progress of the arts and manufactures of our country; but it is both our duty as scientific journalists, and our spontaneous feeling as men, to warn our countrymen against the dangers to which they may expose themselves, by stretching beyond its due limits, the application of any product of our manufacturing ingenuity. We are fully aware of the advantages which belong to the use of iron, in the construction of iron steamers; but we also wish our readers to be fully impressed with a sense of their recklessness in daring all its dangers. We should not fulfil our duties towards them, did we not distinctly tell them, that the iron vessel is in precisely the same condition with respect to the compass, as if no compass had ever existed,—or, in some respects, even a worse condition,—since they may be led to trust to a guide that *cannot* guide them aright and neglect those slight glimpses of indication which may in some small degree assist them. Such, at least, is *our view* of the matter; and if we are wrong, we hope we need not say, that we shall be extremely glad to be enlightened on the subject, by those who see better than we can.

We do not think it necessary to give here Captain Johnson's determination of the best position for a sailing compass on board the *Garryowen*, as, even abating all other objections to the use of this kind of vessel, we have given good reasons why it could not be depended on for any other vessel similarly built,—much less for one in which a different disposition of materials may be adopted. On the care bestowed upon the experiments, as well as on the *evident honesty* of their record, we cannot speak too highly, and we are glad to find such men are found by the Admiralty, to be entrusted with this class of expeditions. We cannot, however, in respect to its scientific value, but regret that a more complete apparatus was not furnished to him, and that a more suitable period, both as to date and extent, was not selected for the purpose.

Mag. Pop. Sci.

On Lightning Conductors, particularly as applied to Vessels. By Martyn Roberts, Esq.

Read before the Electrical Society of London, June 24th, 1837.

As accidents, attended with loss of lives and property, are constantly occurring in our Royal Navy and Mercantile service, from the effects of lightning, notwithstanding the provision often made for their defence, I have been induced to turn my attention to the subject, as well in a philosophical, as in a nautical point of view, and I trust *by an examination of the causes*, and a *citation of a few effects* consequent upon them, *to solve the emburrass-*

ment under which we now lie, and *to point out the means* whereby such disastrous consequences may in future be prevented.

The causes may be traced to two principal heads, namely, the form, and the position, of the conductor used at sea. The conductor most in use is a chain, each link of which becomes, by the action of the saline moisture of the atmosphere, highly oxidated, and as oxide of metal is a non-conductor of electricity, we have at every junction of one link with another, a solution of continuity in the chain regarded as a conductor of electricity, and therefore when the vessel is struck by lightning, every joint of this conductor becomes a point at which an explosion may take place, and where consequently the electric fluid may strike off in any direction whatever.

Its position, when the royal and top-gallant masts are struck, is often productive of danger and inconvenience, for the portion of chain not then stretched, (the spare part) is allowed to remain on deck, or towed overboard, either position being one of danger to the ship. The other form of conductor used is that invented by Mr. Snow Harris, with considerable ingenuity, but, in my humble opinion, by no means tending to diminish the danger. Mr. Snow Harris' plan is to let into the after part of the masts a strip of copper, of considerable surface, but of little thickness, (under the conviction that superfices, not content, conducts electricity,) from which opinion I must beg leave to differ, as it is decidedly contrary to experiment; and if he made his strips thick enough to be efficient, they would materially injure that essential quality in masts, pliability.

While differing so widely from a gentleman for whose talents I have the greatest respect, I feel myself called upon to lay before the society a few of the effects likely to result from an adoption of the system he advocates.

As before mentioned, he proposes that a strip of copper be let into the after part of each portion of the mast, viz: the royal, top-gallant, top, and lower mast, through the keel into the water.

Now, in the first place, at every joint of the mast there must be a separation in the copper to allow the masts to be lowered, the same effects must be expected as have been condemned in the chain; and even supposing the lightning to pursue its course downwards over the copper strip, it appears to me highly dangerous to conduct such an immense accumulatiou of electric fluid as that in a lightning cloud, into the body of the vessel, close, generally speaking, to the powder magazine, or at all events among many substances that would produce awful effects from its action on them: the lateral explosion, of which I here speak, can easily be proved by experiment, to take place even in the transmission of the feeble quantity of electricity generated by our machines, what great reason then have we to dread the enormous quantity of the fluid which will be conveyed into the hull of the ship? Indeed Mr. Harris himself gives an instance of most serious injury, arising to a sailor leaning against a mast through which the lightning was transmitted.

From what has been instanced, I feel confident that few will dissent from the position I wish to defend, *that a perfect metallic continuity of conduction from the mast head to the water, and also a transmission of the fluid through a channel far removed from the interior of the ship, is absolutely necessary for the protection of vessels from Thunder Storms.*

To attain this desideratum *under all circumstances*, I beg leave to propose the following plan.

Let conductors be made of metallic rope, consisting of some hundreds of fine annealed copper wires, laid up as a common hemp rope; it will be pliable, and may be rove through blocks, and traverse as well as any other

rope. Let this rope be fixed to a copper point at the highest mast head, led down the after part of the mast, until it arrives at the lower mast head, and from thence led as a backstay to the outside of the ship, and there fastened to her copper sheathing. By this means a perfect metallic conducting channel is maintained for the lightning, from the highest point to the water, without interruption or contact with any thing that can possibly produce ill effects.

Annals of Electricity.

West's Patent Forge-backs.

The rapidity with which forge-backs of the ordinary construction are destroyed by the intensity of the heat to which they are continually subjected, has led to the invention now described, and which was patented by Mr. West, of Crayford, a blacksmith, in December, 1834. The invention consists in the introduction of a current of water behind the forge-back, which, as is obvious, preserves the metal from destruction by the fire.

Fig. 1.

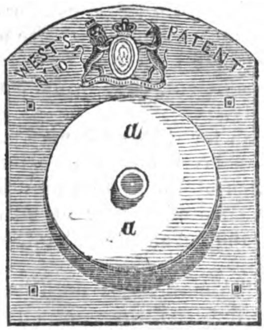


Fig. 2.

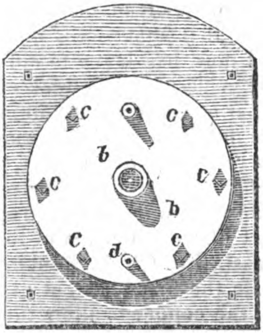


Fig. 3.

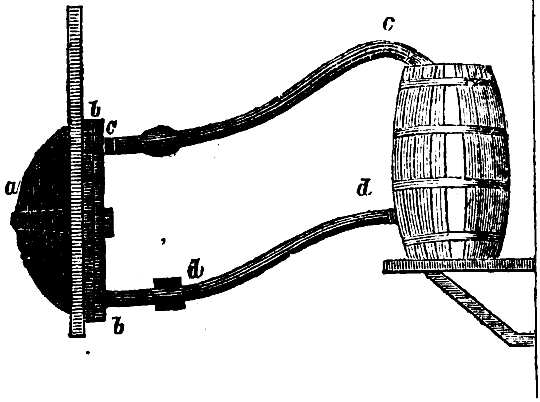


Fig. 4.

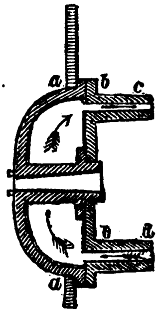


Fig. 1, represents a front view of a forge-back, which is made hollow in order to admit of a flow of water.

Fig. 2 is a back view of fig. 1, by which the position of the circulating pipes is shown.

Fig. 3 is a side view of a forge-back.

Fig. 4 is a side section, by which the action of the water will become more evident, the arrows indicating the flow of the water.

The back of the forge is made up of two parts, *a* and *b*—the part *a* being the front, or part against which the fire or hot coals lie, and is consequently that part in the ordinary back which is liable to be quickly destroyed; but when constructed in such a manner as to admit of a constant flow of water against the back surface, this part *a* will be less prejudicially acted on by the hot coal, owing to the heat being constantly conveyed away by the circulation of the water. *b* is the back part of the forge-back. These parts are kept together by screws. *d* is the induction pipe, and *e* the eduction pipe, which respectively lead from and to a tub or vessel containing water, which is placed in any convenient situation in order that water may constantly flow to and from the hollow forge-back *a b*.

The advantages of these backs are their indestructibility—that the clinker does not adhere to the back, and consequently that the fire need never be disturbed for the removal of the clinkers—that they always burn coal; and as every smith is aware that they never work so comfortably, nor get their heats so well as they do while the back of the forge continues cool, this must be a great recommendation.

There is also a positive saving of more than twenty per cent in coals.

The tub or vessel for the water may be placed in any part of the shop, so that it is above the level of the back, and one tub or vessel will do for any number of backs.

The back is to be connected to the reservoir or tub by leaden pipes.

Lond. Mech. Magazine.

Smoke Burner.

The following is a short description of Messrs. Chanter and Gray's smoke burner, which has been publicly exhibited at their premises, in Earl street, Blackfriars, and inspected by their Royal Highnesses the Dukes of Sussex and Cambridge—the former attended by several Fellows of the Royal Society. It has also been inspected by many engineers and gentlemen interested in the progress of science, all of whom agreed in admitting the object of consuming the smoke to be fully accomplished. It will, therefore, really be a great neglect on the part of the Legislature, if manufactories and gas works are longer suffered to darken the atmosphere of the metropolis with coal smoke. As to the parties interested in locomotive engines, they must decide for themselves; but if the estimate be correct, that they can obtain from coal a heat greater than they now obtain from coke, and at less than half the expense, it may readily be supposed that they will soon avail themselves of this patent.

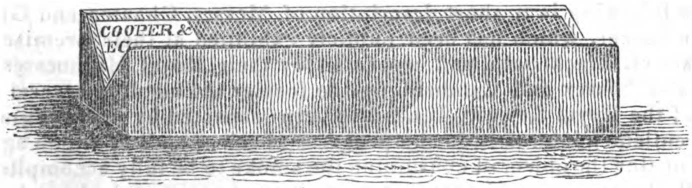
Description of the Smoke Burner.

It would be impossible to describe fully the nature of this invention within the limits of a prospectus, but it may be briefly stated that its principle essentially consists in so arranging the form of the furnace and position of the bars, that the fuel is regularly advanced by gravitation upon inclined fire bars, without the aid of machinery, or any apparatus

besides the simple instruments in common use for the management of furnaces; the carbon and various inflammable gases are set free in the process of combustion, and being more charged with the oxygen of the atmosphere and heat of the fire, proceed through and over the fire, which, increasing in heat to its termination, gradually subjects the less combustible gases to perfect combustion. Saving in fuel is thus effected; for, in the present furnaces, these are not only passed off unconsumed, but by preventing the ignition of more combustible materials, necessarily waste a large portion of the burning fuel. Thus the primary effect, in the operation of the patent furnace, may be stated to be that of obtaining, at the termination of the furnace, that intense degree of heat indispensable to the entire combustion of the various substances emitted from the burning fuel. It is needless to add, that this produces extraordinary economy of fuel. This invention is exhibited in the specification in twelve different forms, showing its application to every description of furnace. The details are somewhat varied; but the most important part of the principle, namely, the absolute combustion of the vapour is thus effected in all of them — Mining Journal.

The Patent Styloxynon.

From the great personal convenience I have myself experienced, in the use of the ingenious little instrument of which a sketch accompanies this communication, I feel assured that I shall be rendering an important service to all such of your numerous readers as are draughtsmen, by introducing it to their notice through the medium of your pages. The drawing, which is the full size, represents Messrs. Cooper and Eckstein's patent pencil pointer, which they have appropriately termed the *Styloxynon*; it consists of two sharp files neatly and firmly set together at right angles in a small block of rosewood.



The instrument thus formed, speedily produces a most delicate point to black lead, slate, or chalk pencils, and will be found generally useful for renewing the points of various other articles in common use.

A point as fine as that of a needle, may be given to good HH or HHH pencils, by means of the Styloxynon, and this instrument will be found an invaluable addition to the drawing table of architectural and mechanical draughtsmen in particular, as well as for artists generally. The mode of using it is merely to rub the pencil backward and forward with the point slightly depressed in the angular groove, turning the pencil round at the same time between the finger and thumb, when a most exquisite point will be produced, which by occasional recourse to the Styloxynon may be maintained at pleasure.

When a new pencil is first used, it should be roughly pointed with a knife before employing the Styloxynon.

WM. BADDELEY.

Lond. Mech. Mag.

Note.—This instrument, if constructed of good coarse files, would be very useful in a laboratory for rounding and fitting corks for jars and bottles. G.

Plan of a Navigable Raft in case of Shipwreck.

Having got together (from the wreck or by other means) a quantity of stout planks, capable of supporting the requisite number of hands with provisions, &c., arrange them side by side in the form of an oblong square, the breadth being one third of the length; then lay at equal distances across them, a sufficient number of others as beams or treadles, to stiffen and hold the raft together, pinning them down with nails, or, if these are inaccessible, with wooden pegs, which swelling in the water will hold firm enough. Now raise the sides and one end perpendicular, (two or more feet according to the size of the raft,) sloping up the other for a bow, like the swim of a barge. The sides being nailed on, should be stayed up with a few brackets inside; and rigging her with a mizen royal, or a couple of boat's sails, with an oar, or paddle shaped plank for helm, the raft is furnished. Half a dozen spare planks slung over the bulwarks by one end, as leeboards, would make her hold an excellent wind. She would be as stiff as a church, and if constructed (as she should be) of large superfices in proportion to her burden, would, from her light draught and extent of floor, be both a fast and a good sea boat. If loaded below the thickness of her bottom, she should be caulked, if otherwise, not, as then any water she might ship escaping between the planks, she would be a life boat and could not be swamped. This plan was originally intended, only as a resource, for the purpose of reaching a civilized port when cast away on a barren, or distant coast; but on reconsideration, I see no reason to hinder its construction on board a vessel, provided sufficient materials are handy. The planks lying flat on deck, would not wash off, but in a very heavy sea. The work is of the simplest and roughest kind, and might be completed in a few hours where the danger is not immediate.

A YOUNGSTER.

Naut. Mag.

Captain Ericsson's Patent Sounding Instrument.

We have been favoured with a copy of the certificate granted by Commander Bisson to Captain Ericsson, which we have great pleasure in subjoining:—

"*To Captain Ericsson.*

"My Lords Commissioners of the Admiralty having ordered a trial of your patent sounding instrument, I was directed by Rear Admiral the Honourable Sir Charles Paget, on the 12th of this month, to proceed in his Majesty's brig Partridge, under my command, towards the Atlantic Ocean for that purpose. I have, accordingly, to certify, that

I have put your sounding instrument to a complete practical test, by using it every second hour, by day and by night, for nine days, beginning with a depth of 5 fathom, and extending to 600 fathoms. Soundings up to 80 fathoms being obtained whilst going at the rate of 6 knots per hour.

"Respecting the accuracy of the instrument, I have only to state that I found it perfect, and as to simplicity, I need only say that all my crew soon understood its use, and on these grounds I can strongly recommend this instrument as being one of great practical utility.

"Philip Bisson, Lieut. and Com.

"Plymouth, this 22d day of Sept., 1836." Lond. Mech. Mag.

A simple method of Drawing on both sides of a Board without either being Rubbed.

To effect this, I think that two slips of wood of the same thickness, provided with pins, say two at each end, and these made to fit in corresponding holes in the drawing board at top and bottom, would be sufficient for the purpose. By these means a sheet of paper could be laid on both sides the board, and be used at the same time by reversing the pieces of wood from one side to the other, as occasion may require. The holes should be near the edge of the board to allow as much room as possible for the paper. Ibid.

Railway Transit.

It would require 12 stage coaches, carrying fifteen passengers each, and 1200 horses, to carry 180 passengers 240 miles in twenty-four hours, at the rate of ten miles an hour. One locomotive steam engine will take that number, and go two trips in the same time, consequently, will do the work of 2400 horses! Again, it would require thirty mail coaches (six passengers each) and 3000 horses, to take 180 passengers and mail, 240 miles in twenty-four hours, at the rate of ten miles an hour. One locomotive steam engine will take that number, and go two trips in the same time, consequently, will do the work of 6000 horses!—*T. M.*

Ibid.

Notices from the French Journals. Translated for the Journal of the Franklin Institute, by J. Griscom.

Fabrication of a Steel called Meteoric Steel. By M. Fischer.

This process consists in combining with cemented steel, or steel of any kind, in variable proportions, certain alloys which have the property of increasing its good qualities and rendering it fit to receive impressions or designs, similar to those of Damask. It is produced in the following manner:

Take 4 parts of zinc, 4 of pure nickel, and 1 part of silver;—put the whole in a black lead or other refractory crucible, cover it well with pulverised charcoal and lute on a cover;—then subject the crucible to the heat

of a powerful melting furnace until the mixture is perfectly fused. Pour it, when very liquid, into a vessel filled with cold water, to render it brittle and carefully pulverise it in a cast iron mortar.

When a sufficient quantity of this powder, which the patent e calls meteoric powder is obtained,

Take 24 pounds of blistered or any other steel,
8 ounces of fine meteoric powder,
6 ounces of pulverized chromate of iron,
1 ounce of wood charcoal,
2 ounces of quick lime,
2 ounces of porcelain earth,

and subject the whole in the ordinary crucible, to the requisite heat. The above proportions produce steel of excellent quality which may be heated and drawn out in the usual manner. When its surface is polished and treated with a mixture of one part of nitric acid and twenty parts of acetic acid, it presents a beautiful damasked appearance. As soon as the acid has taken thorough effect, the piece is to be carefully washed.

Bull. d'encour.

Process for rendering wool, dyed or not dyed, fit for spinning without oiling.
BY M. PIMONT.

Boil water, pure or alkaline, in a strong digester provided with a safety valve, and conduct the steam through a copper tube into a tight metallic vessel containing the wool to be prepared. The action of the steam, under strong pressure, penetrates the wool, thoroughly extends it, and expands it so that it can be spun without oil. Ibid.

Fabrication of a Black Enamel, known under the name of Nielle. BY M. M. WAGNER AND MENTION.

This is composed of an ounce of silver, two ounces and a quarter of copper, one ounce and five eighths of lead, half an ounce of borax, and twelve ounces of sulphur.

The sulphur is put into a retort and the silver and copper into a crucible; when the metals are melted add the lead, and pour the whole into the retort, and close it tightly to prevent the inflammation of the sulphur. Before the mixture is calcined, add the borax, to refine and purify the mixture, and then continue the calcination, until neither flame nor smoke appears in the neck of the retort. Pour the contents into an iron pot. This alloy is hard enough to receive a polish like silver and supple enough not to scale. After pulverizing it, wash it in filtered water, mixed with sufficient quantity of sal ammoniac to acidulate the water, which separates all impurity from the alloy;—pour off the fluid, and wash the material again with clear water, to which a little gum arabic has been added.

When the surface to be enameled has been well prepared, apply the nielle by means of a spatula, the gum arabic attaches it without rubbing in the lines made by the graver. Place the article thus covered in a muffle in the enamelling furnace and let it remain until the Nielle is melted. Then

withdraw it from the muffle, and if the enamel is melted clear and without blisters, polish it by the means and processes used for polishing silver.

Ibid.

New mode of preparing bicarbonate of potash. By Wohler.

Carbonate of potash, either dry or in solution, as is well known, absorbs the second atom of carbonic acid, which is necessary to its transformation to the bicarbonate, very slowly. Wohler found that the porous state of charcoal mingled with this salt, facilitated, in an extraordinary manner, the formation of bicarbonate. The following method is adopted. Crude tartar is carbonized in a covered crucible,—the carbonized mass is slightly moistened with water, placed in a suitable vessel, and carbonic acid gas is passed through it. The gas is absorbed with such rapidity that the mass grows so warm as to make it necessary to surround the vessel with cold water to prevent the decomposition of the bicarbonate formed. The moment of saturation is known by the diminution of temperature. The material is then lixiviated with the least possible quantity of water of 90° or 100° Fahr. and as the filtered solution cools, the greater part of the bicarbonate of potash is deposited in fine crystals.

Jour. de Pharm.

Noticè of a New Process for making Bricks, Tiles, &c. Invented by M. Terrasson.

After remarking upon the properties necessary in a machine that shall completely fulfil the objects of an artificial brick maker, the difficulties to be surmounted in such an invention, especially that which arises from the adhesion of the clay to the mould, and the failure, wholly or in part, of all former contrivances for this purpose, the inventor thus describes his plan:

This machine is divided into two parts.

1. Machine for kneading the clay.
2. Machine for moulding and transporting the bricks to the area, or yard.

The same motive power may accomplish both objects.

Machine for Kneading.—Horse or water power, &c., may be used at pleasure. That which I use at Teil is moved by two horses. The yard is on the side of an argillaceous hill. Two large sheds are erected, one of which is two stories high; the upper serving for the horse floor, the large wheel, and the several connecting parts. The ground floor below contains the moulding and transporting machine.

The other shed is a drying room and store house; it is situated so as to serve as a place of discharge by the shortest way possible.

The hill forms a slightly inclined plane; it furnishes the earth, and from its position facilitates the transportation of the clay.

Machine for Kneading and drawing out the Clay.—Two horses attached to the two arms of a lever, turn a large wheel connected with a trundle, which impels a vertical shaft working in a cylinder or field vat. This shaft is furnished with spiral cutters;—the moistened earth is put into the vat, the cutters in turning, knead it, divide it, and force it, by its own weight and the impulsion of the screw, which operates like the screw of Archimedes, excepting that it reverses the motion. The clay arrives at the bottom of the vat exceedingly well prepared, and then passes through a hole,

round or square, which may be enlarged at pleasure by means of a screw which presses against a slide. We thus obtain a roll or fillet of clay of any desired dimensions.

Machine for Moulding and Transporting the Bricks.—This machine, which gears in to the one above, is placed below the vat in such a manner that the clay, already formed of a due calibre, enters the mould, which is nothing more than a chaplet or hollow frame, moving horizontally, with an adjusted velocity, and turning upon and around cylinders. A large cylinder is placed over the mould, and another below, forming a rolling press which flattens and compresses the clay.

After having passed with the mould under this large cylinder, the clay is perfectly level or even; a boy having previously placed boards in the mould, and upon these boards the bricks are made. The frame returns empty, the boards continue their horizontal course, bringing a fillet of clay well pressed and levelled; two wires, stretched by a weight, and placed on each side of the board, free the clay, and remove all the roughness which, in being stripped, the mould might have left on the fillet.

The boards continue their horizontal course, being urged forward by those which the child continues to place in the mould; they arrive at a point immediately under one end of a balance weight (bascule) formed of a frame, across which wires are stretched, and which, as the weight falls, cut off, in the twinkling of an eye, ten or twelve bricks. The machine stops an instant to give time for this important operation, which may be repeated five times in a minute. A clock bell gives notice when the stroke is given. When the bricks are cut off, and the balance weight rises, the chaplet continues its motion, and two boys take hold of the board.

By means of a long file of cylinders upon a slightly inclined plane, the boards are carried to any desired distance without labour, being hurried down like wagons on an inclined railroad.

I have stated that five strokes of the balance weight may be given per minute, making fifty bricks of large size. By dividing them, 100 of less size would be made;—indeed, if the children could take them off, 150 might be made, a result which, however incredible, is nevertheless true, as I have proved before the authorities of the country, who were quite incredulous before they saw it. I have even gained bets upon it.

I have hitherto employed only horse power, but there would be great advantage in using steam, wind, and especially water; the velocity of the shaft being more regular and rapid with a water fall, and with a greater force than two horses, the kneading and other operations would be better performed.

By a similar arrangement, tiles are made, earthen water pipes may be moulded, concave bricks for vaults, and in fact all sorts of bricks, refractory and others. Receuil Industriell.

Progress of Physical Science.

Minimum Density of Liquids. By C. Despretz.

Two memoirs, one on the maximum density of pure water and the other on that of saline solutions, were read before the *Academie des Sciences* and an account of them given in the *Comptes Rendus de l'Academie*, by Gay

LUSSAC, ARAGO and BECQUEREL. This has been translated by W. FRANCIS. G.

After noticing and trying several methods, the author states, "the process which appeared to me to be the most suitable, was to compare the progress of a water thermometer with a mercurial thermometer. For this purpose I constructed six water and four mercury thermometers. All these instruments were divided into parts of equal volume. In order to get rid of the error which arises from the conical form of the tubes, I disposed them so that the variation in the size of the diameter took the one direction and the other alternately. In the first experiments the instruments were placed in the midst of a liquid which was gradually made cold; and after it had passed the apparent maximum, the apparatus was left to the calorific influence of the surrounding bodies; it then became warm, and arrived at the point of departure. By performing the experiment so that the heating kept equal pace with the refrigeration, the error occasioned by the want of coincidence between the water thermometer and the mercury thermometer was avoided; the first being always behind the second. I also lessened very much this cause of error by taking the mean of the results obtained; nevertheless I preferred observing in the statical condition.

After various essays, which need not be enumerated, I adopted the following apparatus.

It consists of a cylindrical copper vessel, similar to a large eprouvette. In this vessel two water thermometers and three mercury thermometers are suspended, the two first alternating with the latter; all the reservoirs are at the same height; the vessel is corked so as to hinder the access of external air. It is then placed in a large earthen vessel filled with a mixture at various temperatures, from + 16° Cent. to the freezing of the water, which takes place at times at —5°, at times at —10°. sometimes at —15°, and even at —20° Cent. We should remember that Gay-Lussac had previously observed water to remain in a liquid state —12° Cent.

Each experiment lasted from eight to ten hours, during which from eight to ten numbers were taken.

The results obtained with the water thermometers, were as follows:

Seven	experiments with	one tube	9°.39C.
Seven	do.	another	4. 02
Two	do.	a third	4. 01
Two	do.	a fourth	3. 96.

The mean from these eighteen experiments is 4° C., which agrees within two hundredths with the result of the former process.

Before and after each experiment the zero of the thermometer was examined. This verification is absolutely necessary, because the zeros of thermometers, even of those which have been constructed for a long time, differ when these instruments are kept for some time at a low or high temperature. We shall have occasion to return to this important fact on another occasion.

So many contradictory results have been obtained on the subject of the maximum of density of pure water, that it is quite unnecessary to mention here in what these experiments may be regarded as more nearly approaching to the truth. They occupied me for a year. I constructed and graduated all the instruments myself. The weighings were performed with the greatest care. Fearful of partial errors, all the results were represented by drawings on a very large scale. I lay before the Academy a few only of the numbers and curves. Although we cannot answer for the hundredth

part of a degree, considering the extreme mobility of glass instruments, we yet remark that the difference of the single results with 4°, a difference which in general has amounted to some hundredths, never surpassed 0°.1, and that the two processes, which have not the least relation with one another, have furnished sensibly the same result. Nevertheless, on account of the importance of the subject, I shall have the honour in a short time of laying before the Academy some experiments made by a process not yet described, and employed at very low temperatures.

This memoir closes with a table of the dilatation of water from degree to degree, from the maximum to the boiling point, and from the maximum to —13° Cent. The dilatation is a little stronger below than above the maximum.

This dilatation amounts $\frac{45}{1000}$ from 4° to 100°.

Various points of the scale have been verified by fixed temperatures, as that of æther, alcohol, &c. The curve of dilatation is almost a parabola for a very considerable space on the scale.

Extract from the Second Memoir.

The question respecting the maximum of density of saline solutions, immediately connected with the researches relative to the temperature of the sea at various depths, has been for a long time agitated among natural philosophers, who, however, are far from agreeing with each other on this subject; thus, as Ermann remarks, while Rumford, Marcet, and Berzelius think that salt water has no maximum, Gay-Lussac, Scoresby, and Sabine, guided by analogy, profess quite a contrary opinion.*

Of the four methods described in my paper on the maximum of pure water, says M. Despretz, one only is applicable to aqueous solutions. It is that in which the course of a water thermometer is compared with that of a mercury thermometer. In the experiments with saline solutions, as in those of pure water, four thermometers filled with saline solutions and four with mercury were immersed in a large vessel, the temperature of which was gradually lowered to six or seven points, which I sought to render fixed. In order to avoid the influence of the warming or cooling of the vessel, thermometers containing mercury and saline solutions were taken alternately. A curve was traced with the apparent contractions and expansions, to which was drawn a tangent parallel to the line of expansion of the glass. The tangential point gave the temperature of the maximum, *i, e*, the point where the expansion is equal to the contraction of the glass, which is evidently the point where the absolute dilatation of this solution is zero. This is the transition of the contraction into the expansion by cold.

M. Despretz did not find a single aqueous solution which did not show a maximum either above or below the freezing point. The solutions which contain 1 to 3 centimetres of foreign matter are in the first predicament; those containing more, in the latter.

Every one can demonstrate the existence of a maximum for any aqueous solution whatever; for this purpose it is only necessary to construct a thermometer with the solution, and to lower the temperature rather slowly: the liquid is seen to contract down to a certain point, and then by a continued refrigeration regularly to expand.

These experiments being very long and laborious, after having proved

*Captain Sabine's remarks on this subject will be found in Phil. Mag. First Series, vol. lxiii. p. 70.—Edit.

the existence of a maximum for any aqueous solution, the author contented himself with extending these researches to eleven different substances: sea water, chloride of sodium, chloride of calcium, carbonate of potash, carbonate of soda, sulphate of potash, sulphate of soda, sulphate of copper, and alcohol.

With the exception of sea water, every substance was dissolved in pure water in seven different proportions. These ten substances therefore give seventy solutions. The nature of the substances was varied, in order to follow the general course of the phenomenon. Among them were deliquescents, efflorescents, bodies which are not affected by the air; some very soluble, others of little solubility.

We will begin with mentioning the results which relate to sea water. I first operated, says M. Despretz, with an artificially formed sea water according to Marcet's analysis; but M. Arago, to whom I mentioned my first experiments, had the kindness to offer me some sea-water collected by M. Freycinet in the Southern Ocean. This water weighed at 20° 1.0273. The mean from twelve experiments gave—2°.55 for the temperature of the freezing point in a state of agitation; at the instant of freezing the thermometer returned to —1°.84 of density. This fluid has its maximum density at —3° 67. This is the mean deduced from five experiments with three different tubes. One tube gave twice —3°·69; a second —3°.60 and —3°.59; a third —3°.77. We now see the reason why Marcet and Ermann did not discover any maximum density in sea water, because they searched for it above the freezing point, while it is situated at more than one degree below.

The solution of the question relative to sea water sufficed for the purposes of physical geography; but the history of corpuscular properties required a more general solution. It was necessary to extend these experiments to a certain number of aqueous solutions in order to discover the course which the maximum takes as the addition of foreign matter lowers it.

For this purpose I dissolved several quantities of foreign matter in the proportions 1, 2, 4, 6, 12, and 24. Each of the substances was employed in a pure state, which it is now very easy to ensure. The chloride of sodium, the chloride of calcium, the carbonate of potash and that of soda were melted. The carbonate of potash was obtained by calcining pure and crystalized bicarbonate. The sulphate of copper was employed crystallized. Water not being an essential part of this salt, it was subtracted; while the pure hydrate of potash, concentrated sulphuric acid and absolute alcohol, (water being in certain respects essential to their composition, since heat alone does not expel it,) were considered as anhydrous bodies. We will mention some of the results obtained:

Sea Salt.

0.009123 of salt	····freezing point*	—1°.21,	Max.	+1°.19	Cent.
0.0246	" "	—2 ·24	"	—1 .69	"
0.0371	" "	—2 .77	"	—4 .75	"
0.0741	" "	—5 .10	"	—16 .00	"

*The temperatures are those marked by the thermometer at the moment when the liquid is on the point of freezing. The temperatures indicating the actual freezing, i. e. which are for the solutions what zero is for pure water, are not so low.

Chloride of Calcium.

0.0371 of salt····	freezing point	—3°.92,	Max.	—2°.43	Cent.
0.0741	"	"	—5°.28	"	10.43 "

This sinking of the maximum, says the author, cannot be the consequence of a partial freezing of the liquid mass, since the curve, representing the expansions above and below the maximum, is quite regular, as the drawings which I now lay before the Academy will show; the freezing of the smallest part would determine, in the curve, points which by geometricians are denominated *singular.* Besides, this partial freezing could scarcely take place without causing the freezing of almost the entire mass. The coincidence also which exists between the experiments performed on the same solution, but with different tubes, excludes all idea of freezing. Thus for the solution of sea salt at 0°.0371, one tube gave —4°.80, —4°.73, —4°.76, the mean of which is —4°.76. A second tube gave —4°,73, —4°.72, —4°.77, the mean of which is —4°.74; which differs from the first only by two hundredths.

We conceive that there does not always exist the same agreement in the partial experiments: many however exhibit but a small difference.

In comparing the various experiments, we see that it is neither the more soluble salts, nor the salts which most retard the freezing point, that lower the maximum most; for instance, the chloride of calcium lowers the maximum much less than sea salt; the sulphate of potash less than the sulphate of soda. This result is obtained whatever may be the degree of concentration of the solutions compared.

The two following results, says Despretz, appear to me to be proved:

1. Sea water, and all aqueous solutions, acid, alcoholic, saline and alkaline, have a maximum of density.
2. This maximum sinks much quicker than the freezing point, the variation of which, as well as that of the density, is nearly proportional to the quantity of matter added to the water.

The point of the maximum remains at first above that of the freezing point; it then reaches it, and finally sinks below it. Even with seven hundredths of salt, acid, or alkali, the maximum may be at 12 degrees below the freezing point, so that it is impossible to discover it except by exposing the fluid solution in narrow tubes to temperatures far below that point.

Lond. & Edin. Philos. Mag.

A Few Words on Astronomy.

If England may be permitted to cast a proud eye upon the period in which Flamsted, and Halley, and Newton flourished, she cannot but contemplate with the bitterest dejection, that which succeeded it. As if Providence had decreed that there should be a balance in the glory as well as in the power of nations, no British name has been allowed to share in the intellectual triumphs which illustrated the middle and the close of the eighteenth century. Truth and justice demand from us this afflicting acknowledgment, while they award to Clairaut, Euler, D'Alembert, Lagrange, and Laplace, the high honor of having completed the theory of the system of the world.

The problem of two bodies, or the determination of the motions of one planet revolving round another, had received from Newton the most per-

fect solution. He had even shown that the problem of three bodies, in which the action of a disturbing planet is introduced, could be resolved by the principles which he had established; and in the case of the lunar irregularities, he had succeeded in explaining no fewer than *five* of the most important. At this point, however, the power of analysis failed, and it was left to a succeeding age to complete the noble edifice which he had founded. The results of the labours to which we allude are developed in the *Mécanique Céleste* of Laplace, a work which ranks next to the Principia; but it would exceed our limits were we to assign to each of the astronomers we have named their respective claims to immortality. By the improvements they have made in the analytical art, they have solved the problem of three bodies, and have computed, with accuracy almost miraculous, the various disturbances which affect the motions of the principal planets. But though all the bodies of the system thus exercise over each other a reciprocal influence, yet it has been proved by Lagrange, that the resulting irregularities are all periodical, and that while the form and position of their orbits are ever changing, their mean motions and mean distances from the sun are subject to no variation. Amid the actions and re-actions of our system, therefore, the general harmony is never broken, and from the arrangements of this celestial mechanism, disorder and decay have been forever excluded. What a sublime and instructive picture is thus presented to man!—while he and every thing around him bears the impress of his fleeting nature,—while even the solid globe on which he treads is rent by convulsions, and agitated in the conflict of its elements, yet does the general system stand unshaken amid the oscillations of its parts, and thus testify to each generation, as it comes, the wisdom and the power with which its great architect has provided for the stability of his material throne.

But though the spirit of English science had thus been slumbering amid the intrigues of faction, and the apathy of shortlived and unenlightening administrations, the exertions of individual genius were preparing in secret for new achievements. The invention of the achromatic telescope by Dolland, and the improvement of the reflectors by Short and Mudge, had armed the observer for the great object of sidereal astronomy—for examining the phenomena and condition of the stars, and the structure of the groups and systems which the telescope descried in the immensity of space. In this period, doubtless the most brilliant in the annals of discovery, the name of Herschel stands in proud pre-eminence, as the founder, and the most successful cultivator, of sidereal astronomy; and when we add the name of his accomplished son, of Dr. Brinkley, (bishop of Cloyne,) of Sir James South, and of Mr. Struve, we complete the list of the great men who have immortalized themselves in this difficult and boundless field of inquiry.

Before we proceed to give an account of their labours, it is necessary that the reader should have some idea of the distance and magnitudes of the bodies which are to come under his consideration. That the nearest of the fixed stars are not placed at immeasurable distances, has been fully established by the numerous and ably-conducted observations of the Bishop of Cloyne. This distinguished astronomer has found that the star *a Lyræ* has a paralyx of 1″. 1, or, what is the same thing, that the radius of the earth's annual orbit, would, if seen from that star, subtend an angle of 1′. 1: hence it follows, that its distance is 20,159,665,000,000 miles, or twenty billions of miles. Sir William Herschel, from repeated measurements, considers the diameter of *a Lyræ* as three tenths of a second, and consequently,

its diameter must be *three thousand times* greater than that of our sun, or 2,669,000,000 miles, or *three-fourths* of the size of the whole solar system, as circumscribed by the orbit of the Georgium Sidus. This extraordinary result does not entirely accord with a curious calculation of the Marquis Laplace, that a luminous star, of the same density as the earth, and whose diameter is two hundred and fifty times that of the sun, would exercise such an attraction over the rays which issued from it, that they could not arrive at the earth; the consequence of which would be, that the largest luminous bodies in the universe would, on this account, be invisible. But however this may be, it cannot be doubted that the scale of distance and magnitude for the fixed stars cannot be greatly different from that which we have stated.

It was to regions so remote, and to bodies so vast, that Sir William Herschel directed his powerful telescopes, after he had extended the limits of our own system, by the discovery of *one* primary and *eight* secondary planets. Professor Kant and the celebrated Lambert had suggested the hypothesis, that all the bodies in the universe were collected into nebulæ, and that all the insulated and scattered stars formed part of the nebula to which our own system belonged. Pursuing this happy thought, Sir William Herschel examined no fewer than 2,500 nebulæ, and he was led to the opinion, that the galaxy, or milky way, was the projection of our own nebula in the sky, and by *gauging* the heavens, or counting the number of stars which occur in the same space in different directions, he was enabled to determine the probable form of the nebula itself, and the probable position of the solar system within it. But while this idea impresses us with its grandeur, it at the same time furnishes us with a scale for estimating the immensity of nature. If all the separate stars which the most powerful telescope can descry, are only part of our own nebula, what must we think of the millions of nebulæ, some of which exhibit, by their proximity, the individual stars of which they are composed; while others, as they recede from our failing sight, display only in the best instruments a continuous and unbroken light, in which the spaces between the stars can no longer be seen? From the systems which roll within these groups of worlds, a new firmament of stars will be seen, and each system will have its milky way, exhibiting the projection of its nebula, varying in form and in lustre with its locality within the group. It is in vain to pursue ideas so vast and overwhelming; it is enough that the mind tries its strength, and stands self-convicted of its weakness.

Let us, therefore, turn our attention to nearer objects—to our own nebula, and the stars which compose it. Not content with determining the probable position of the solar system within the nebula of the milky way, Sir William Herschel conceived the idea of ascertaining whether that system was stationary, or movable. By a comparison of the proper motions of the fixed stars, he determined that the solar system was advancing towards the constellation Hercules, and that, if it were viewed from one of the nearest of the fixed stars, the sun would appear to describe an arch of about *one second.* In reasoning respecting the insulated stars, which belong to what we may now call the *solar nebulæ,* he justly conceived that those which were double must form a *binary system,* or systems, in which the two stars revolve round their common centre of gravity. We have said in many cases, because there can be no doubt that two stars may often form a double star, when they have no connexion with each other, but that of similarity of direction. The same conception is applicable to more complicated systems,

and he has shown how three or more stars may be permanently connected, by revolving in proper orbits round a common centre.

These views, at first entirely speculative, received from subsequent and long-continued observation a very remarkable confirmation. If we suppose a line to join the centres of the two stars which compose a double-star, then if the two stars have no relative motion, this line must form an invariable angle with the line or direction of their daily motion. By means of an ingenious position micrometer, Sir William Herschel determined this angle, (called the *angle of position,*) for seven hundred and two stars, between 1778 and 1784. After a lapse of twenty years, he repeated his observations on the same stars, between 1800 and 1805, and he had the satisfaction of finding, that in more than fifty double stars, there had been a decided change either in their distance, or in the angle of position. In this way he discovered that one of the stars of *Castor* revolved round the other in three hundred and forty-two years; and that the small star of γ *Leonis* performed its circuit in 1200 years, and that of ε *Bootis* in 1681 years, that of δ *Serpentis* in 375, and that γ *Virginis* in 708 years.

By this great discovery, the greatest, unquestionably, in the history of astronomy, the existence of systems among the fixed stars was completely established; but so far did Sir William Herschel's labours transcend those of the age in which he lived, that no attempt was made to repeat and to extend them. They were scarcely admitted into any astronomical work; they were ridiculed by men whose reputation had been eclipsed by his own; and they were received with a sort of incredulous wonder, even by the most ardent lovers of astronomy. The progress of knowledge and of discovery had paved the way not only for the highest achievements of Newton and Laplace, but also for their immediate reception among philosophers; and had these great men never lived, science would, in a very few years, have received from other minds the same splendid accession. The discoveries of Herschel, on the contrary, exhibited no continuity with those of his predecessors. Before his day, sidereal astronomy had no existence; nor had the wildness of speculation ventured even to foreshadow its wonders. Entrenched in the remoteness of space, among spheres which no telescope but his could descry, her walls were unscaled, and her outworks even unapproached. His genius, however, enabled him to surmount barriers hitherto impregnable, and conducted him in triumph into the very stronghold of her mysteries. The cessation of such gigantic labours would have been afflicting to science, had not that same wisdom which provided for the continuity of his name, provided also for the continuity of his labours.

In the year 1816, four years before the death of his venerable father, Sir John Herschel had begun a re-examination of all the double and triple stars, and had made some progress in it. The same idea had occurred to Sir James South, one of the most able and enterprising astronomers of the present day, and it was agreed that they should undertake the work in concert. They accordingly began in March 1821, and continuing their observations in 1822 and 1823, they were enabled to communicate to the Royal Society in January, 1824, the position and apparent distances of 380 double and triple stars, the result of above 10,000 individual measurements.* The instruments which they employed were two achromatic telescopes mounted equatorially: the object-glass of the smallest had an aperture of three inches and three quarters, and a focal length of five feet, and was made by the

*This Memoir was honoured with the astronomical prize of the French Academy of Sciences.

late P. and J. Dolland. The power usually employed was 133, but powers of 68, 116, 240, 303, and 381 were sometimes used. The largest telescope was *seven* feet in focal length, with an aperture of *five* inches, and is supposed to be the best Tulley ever executed. The power commonly employed was 179, though 105, 273, and sometimes 600 were used.

No sooner had Sir James South completed his share in this great work, than he began another series of observations of equal difficulty and importance. They were made principally at Passey, near Paris, with the instruments above mentioned; and in November, 1825, he communicated to the Royal Society the apparent distances and positions of four hundred and fifty-eight double stars, of which one hundred and sixty had never before been observed.

While these observations were going on in England, an able continental astronomer, M. Struve, director of the Imperial Observatory of Dorpat, in Livonia, had occupied himself with the same subject; for such was his assiduity and zeal, that in four years he completed his *Catalogus Novus Stellarum Duplicium et Multiplicium*, containing no fewer than three thousand and sixty-three stars.* These observations were chiefly made with a telescope by Frauenhofer, which the Emperor of Russia had presented to the observatory of Dorpat. This magnificent instrument has a focal length of thirteen feet, and an aperture of nine inches, and cost thirteen hundred pounds. The king of Bavaria followed this noble example by ordering a still finer instrument for the same purpose; and the king of France, with a liberality still more patriotic, has had executed in his own capital an achromatic telescope, surpassing them all in magnitude and power. What a mist is it to English science, that the name of the most accomplished prince who has yet occupied the throne of Charles I. does not appear in the list of sovereigns who have thus been rivalling each other in the patronage of astronomy! What a mortification to English feeling, that the subject of sidereal astronomy created by the munificence of George III. should thus be transferred to the patronage of foreign monarchs.

In taking a general view of the labours of Sir John Herschel, and Sir James South, it appears that there are *sixteen* binary systems of stars perfectly established, and at least *fourteen* of which the annual motion is not exactly determined.

The established binary systems, with their periods and annual motions, are given in the following table. The signs ÷ and — indicate the different directions of the motion.

Names of stars.	Periods. Years.	Annual motion.
ξ Ursae Majoris	51	—7°.02
70 p Ophiuchi	53	—6.81
σ Coronæ Borealis . .	169	—2.13
Castor	370	—0.971
6 1 Cygni	493	÷0.73
δ Serpentis	496	—0.726
γ Virginis	540	—0.667
s f μ Bootis	623	—0.58
μ Draconis	623	—9.58
12 Lyncis	646	—0.56

*The labours of this indefatigable astronomer have been rewarded by the Royal Society of London with one of their gold medals.

10*

Names of stars.	Periods. Years.	Annual motion.
η Cassiopeiæ	700	—0°.513
49 Serpentis	706	+10.5
Aquarii	804	—0.448
ε Bootis	822	+0.438
5 Lyræ	1108	—0.325
γ Leonis	1200	+0.30

Of these stars, ξ Ursæ Majoris possesses a very peculiar character, as *the two stars revolve round their common centre of gravity with a motion so rapid as to admit of being traced and measured from month to month.*

Another object of very peculiar interest to astronomers is ζ *Herculis*, which both Sir John Herschel and Sir James South have found to be *single*, with the best telescopes. In July, 1782, however, it was a distinct double star, the greater being of a beautiful bluish white, and the lesser of a fine ash colour. In 1782, Sir William Herschel found the interval between the two stars to be one half the diameter of the smaller one. In 1795, he could with difficulty perceive the small star. In 1802, he could no longer perceive it; but in a very clear night, the apparent disc of ζ *Herculis* seemed to be lengthened in one direction. In 1803, with a power of 2140, he found the disc a little distorted, but he was convinced that about three eighths of the apparent diameter of the small star was wanting to make the occultation of it complete. The Dorpat telescope has since separated these two stars.

It is scarcely possible, we think, to peruse the preceding details concerning the history and present advanced state of astronomy, brief and imperfect as they are, without looking forward with the most intense interest to the future progress of science. Even within our own system much remains to be investigated. The nature of the sun, and the constitution of its surface in relation to the more or less copious discharge of light and heat; the physical condition of the moon, which may yet exhibit among her mountains the works of living agents; the theory of four new planetary fragments, which hold out to physical astronomy some of its most perplexing problems; the forms, rotations, and the densities of most of the secondary planets, are all subjects fraught with the deepest interest to astronomers. The comets, too, those illusory bodies of which we scarcely know whence they come, or whither they go, have now been brought within the grasp of regular observation. The discovery of two comets with short periods, one of three and one-third years, revolving within the orbit of Jupiter, and the other with a period of five years, revolving within the orbit of Saturn, enables us to observe them period after period, and to study their motions as well as their physical constitution. But how shall we describe the future prospects of sidereal astronomy? In our own nebula we may trace the motion of the solar system round some distant centre; we may discover the causes which produce the phenomena of variable stars; and we may witness the extension of the law of gravity to the movements of binary, and even more complicated, systems. Among the nebulæ beyond our own, discoveries still more extraordinary await us. May we not see even the operations of those powerful agents by which whole systems are formed, and of those still more tremendous forces by which other systems are destroyed? In the changes of particular nebulæ, and in the condensation of nebulous matter into lucid centres, and even into central stars, we recognize the first of these agents; and in the sudden disappearance of the most brilliant stars, we have some indication of the second. Thus may we study, in these distant regions, the

active operations of creative power; and thus, in relation to the past and the future in our own globe, may we be permitted to witness the types of those great events which are necessarily excluded from the short span of our existence.

Nautical Magazine.

On the Results of Experiments made on the Weight, Height, and Strength of above 800 *Individuals. By* JAMES D. FORBES, ESQ., F. R. SS. L & E., Professor of Natural Philosophy in the University of Edinburgh.*

The interesting and remarkable experiments published by M. Quetelet of Brussels, on various points of physical developments in man, under a variety of circumstances, as to climate, station, age and sex, induced me to take the opportunity which my professional position presented of obtaining the measure of physical development as to the weight, height and strength of natives of Scotland between the ages of 14 and 25, students of our University.

In the prosecution of this plan, separate lists were kept of persons not born in Scotland, and of these, the English and Irish lists have likewise been subjected to calculation. Though of these the numbers are comparatively small, the results present some pretty decisive characters. These experiments were continued during two winters (1834–5, 1835–6;) every experiment was made by myself, and noted down by myself. The weights were ascertained by Marriot's spring balance, which was verified from time to time, and found to have undergone no change in its elasticity. The weight of clothes is included.† The heights are in English inches, shoes included. For the measure of strength, Regnier's dynamometer was employed, and these experiments were somewhat less satisfactory than the others. The error of the instrument had been ascertained before the commencement of the experiments, and was found to be pretty constant throughout the scale. But after the experiments were finished, this was by no means the case, the error having become variable owing to the interfering action of a small spring employed to bring the index to zero. As this, however, only affects the absolute results, (or, at least, its relative influence is trifling,) I have contented myself with applying an interpolated correction deduced from the mean of the errors before and after, which cannot differ much from the truth. But the instrumental errors are not the only ones to be contended with. To avoid errors in the *use* of the dynamometer requires vigilant superintendence on the part of the observer; and as the first pull is generally, (though not always,) greater than the second or third, this also must be allowed for. I have invariably repeated the experiment three times, and often much more frequently. When extraordinary cases have occurred, I have taken the precaution of observing at distinct intervals of time.

In ascertaining the mean results, the following method has been adopted: the natives of each country were separated, and each class divided, according to age, into twelve sets, from 14 to 25, the greatest number being of the age of 18 years. The mean weight, height, and strength, for each year, was computed, and the result projected upon ruled paper.

*Read to the Royal Society of Edinburgh: and communicated by the author.

†According to Quetelet, this amounts to 1–18th of the weight.

Curves were drawn through the points thus projected, in such a way as to represent most satisfactorily the whole observations. These curves, with the determining points, are now exhibited to the Society. It is proper to add that the ages registered being the ages *at last birthday*, the weight, &c., registered, is not that due to the age noted, but at a mean to an age half a year later. Thus all the persons who were 20 last birthday are *between* the ages of 20 and 21, or 20½ at a mean. This has been attended to in making the projections.

Besides the English, Scotch and Irish curves, I have exhibited those of the Belgian development, from M. Quetelet's experiments, reduced to English measures. The thickness of the shoes not being included in these experiments, half an inch (perhaps too little) has been added to make them comparable with the others. It is important to add that M. Quetelet's experiments here quoted, as well as my own, were made upon persons in the higher ranks of life, in both cases, in fact, upon persons having the benefit of academical instruction.

The number of persons examined by me in the two winters before stated was thus divided: Scotchmen, 523; Englishmen, 178; Irishmen, 72; from the Colonies, &c., 56; total, 829. I was careful to obtain a fair average of persons of all degrees of height and strength, in which respect the Scotch average is more unexceptionable than the others. There is always a tendency in such cases to get too high a development, because diminutive persons are the least likely voluntarily to come forward. An example of this is found in the mean height obtained by M. Quetelet, from a register of 80 individuals at Cambridge between the ages of 18 and 23, giving a mean of 69.6 inches, instead of 68.7 as my experiments indicate.

The numerical results derived from the graphical process before described are given at the close of the paper, and seem to warrant the following conclusions:

1. That in respect of weight, height, and strength, there is a general coincidence in the form of the curves with those of M. Quetelet.

2. The British curves seem to have more curvature for the earlier years, (14 to 17,) or the progress to maturity is then more rapid, and somewhat slower afterwards. If we may depend upon the English curves, this is more strikingly the case in natives of that country than of Scotland, at least in point of weight and strength.

3. The tables incontestibly prove the superior development of natives of this country over Belgians. The difference is greatest in strength, (one fifth of the whole,) and least in weight.

4. In comparing natives of England, Scotland, and Ireland, more doubt arises, owing to the difference in the number of experiments; those for Ireland are confessedly most imperfect. Yet I conceive that the coincident results in the three tables entitle us to conclude that the Irish are more developed than the Scotch at a given age, and the English less. Some qualification is, however, due, in consequence of the remark, (2;) for in the earlier years, (14—17,) it would even appear that the English so far get the start of the Scotch, as not only relatively, but also absolutely, to surpass them (in strength and weight;) but between 17 and 19 they lose this advantage. I am disposed to think that this appearance of a result is not accidental.

5. The maximum height seems scarcely to be attained even at the

age of 25. This agrees with M. Quetelet's observatisons. Both strength and weight are rapidly increasing at that age.

6 In the given period of life, (14—29,) all the developments continue to increase; and all move slowly from the commencement to the end of that period. Hence the curves are convex upwards. [This is not the case below the age of 14, for weight and strength. Quetelet.]

TABLES.

Weights in Pounds (including clothes.)

Age.	English.	Scotch.	Irish.	Belgians.
15	114.5	112	....	102
16	127	125.5	129	117.5
17	133.5	133.5	136	127
18	138	139	141.5	134
19	141	143	145.5	139.5
20	144	146.5	148	143
21	146	148.5	151	145.5
22	147.5	150	153	147
23	149	151	154	148.5
24	150	152	155	149.5
25	151	152.5	155	150

Heights in inches. Full dimensions (with shoes.)

Age.	English	Scotch.	Irish.	Belgians.
15	64.4	64.7	....	61.8
16	66.5	66.8	....	64.2
17	67.5	67.9	....	66.1
18	68.1	68.5	68.7	67.2
19	68.5	68.9	69 4	67.7
20	68.7	69.1	69.8	67.9
21	68.8	69.2	70.0	68.0
22	68.9	69.2	70.1	68.1
23	68.9	69.3	70.2	68.2
24	68.9	69.3	70.2	68.2
25	68.9	69.3	70.2	68.3

Strength in Pounds.

Age.	English.	Scotch.	Irish.	Belgians.
15	....	208	....	204
16	336	314	....	236
17	352	340	369	260
18	364	360	389	280
19	378	378	404	296
20	385	392	416	310
21	392	402	423	322
22	397	410	427	330
23	401	417	430	335
24	402	421	431	337
25	403	423	432	339

Lond. and Edin. Philos. Mag.

The foregoing results are certainly very interesting and I would respectfully suggest that the Professors at the Medical Schools of Philadelphia, at their next sessions, determine the state of their respective classes on the same points at least, which have received the judicious attention of Professor Forbes. G.

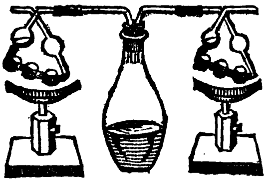
On the Frozen Soil of Siberia. By Professor BAER of St. Petersburgh.

It has long since been ascertained, says M. Baer, that over a great extent of country, the soil of Siberia is never entirely free from ice; during the summer, the surface of the ground is, to a greater or less depth, thawed; but at some distance from the surface, a bottom of perpetual ice is met with. Gmelin the elder, in his travels in Siberia, states that shortly after the foundation of the town Yakutzk (in Lat. $62\frac{1}{2}°$ North; Long. 130° East nearly,) at the end of the seventeenth century, the soil of that place was found to be frozen at a depth of 91 feet, and that the people were compelled to give up the design of sinking a well. Many other facts of this description were collected by travellers about the middle of the last century; but these facts seem not to have been generally credited; and even in 1825, Leopold Von Buch, a philosopher whose opinion is of the greatest weight in all questions connected with the physical condition of the globe, rejected these statements as entirely erroneous; yet they have been corroborated in our days by the travels of Erman and Humboldt. Until very lately, nothing was known respecting the thickness of the frozen surface; but within these few years a merchant of the name of Schargin, having attempted to sink a well at Yakutzk, was about to abandon the project in despair of obtaining water, when Admiral Wrangel persuaded him to continue his operations till he had perforated the whole stratum of ice. This he did, and kept a complete journal of his work. The well, or pit, of M. Schargin had been sunk to the depth of 382 feet, and at that distance from the surface, the soil was very loose, and the temperature of the earth $\frac{1}{2}°$ Reaumur (31° Fahr.,) but nearer the surface it had been much lower, and had increased as follows: Reaumur, 6° at some feet below the surface; 5° at 77 feet; 4° at 119 feet; 2° at 217 feet; $1\frac{1}{2}°$ at 305 feet; $\frac{1}{2}°$ at 350; $\frac{1}{2}°$ at 382 feet. As the soil had already become loose at 350 feet, and as the aperture of the well was eight feet square, and the work carried on partly during winter, when, of course, the column of cold air must have rushed into the pit and chilled the temperature, it is probable that the spot at which the thermometer marked the freezing point, was at the depth of 350 feet. This immense thickness of ground ice would prove that Siberia must have been for a long period in the same physical condition as it is at present. In the actual state of our information on this subject, it is impossible to determine how widely this layer of ground-ice is spread under the surface of Siberia; yet we know enough to say that it extends over an immense tract of country. Humboldt found the soil frozen at a depth of six feet at Bosgolowsk, near the Ural, in 60° North Lat. Near Beresow, Erman found the temperature of the earth at a depth of 23 feet, still $+1°.6$, ($35\frac{1}{2}°$ F.,) but in 1821 a dead body was disinterred, which had been buried 92 years before; the earth around it was frozen, and the body did not shew any signs of decomposition. It has long been known that at Oodorsk, in North Lat. 68°, the ground is always frozen. Near Tobolsk no ice is found in the soil, but as we proceed to the eastward, the ground ice advan-

ces farther north. It is to be hoped that measurements of the temperature will shortly be made at different depths at Yakutzk, and by methods which M. Schargin was unable to employ; also it is desirable to institute an inquiry as to the depth at which the ice annually disappears near the surface, and collect information on the depth of ground ice generally in Siberia. It would also be highly gratifying to me, and extremely interesting to science in general, if the Geographical Society of London would collect information respecting the extent of the layer of ground ice in North America, the thickness which it attains, and how much of it disappears by the summer heat, in those countries over which the factories of the Hudson's Bay Company are disseminated. At the termination of the reading of this paper, an animated discussion took place on the frozen soil of Siberia, in which the members stated their views on the subject. It appears to be generally considered, that the experiment at Yakutzk had not been made with sufficient care, to authorize the belief that the frost penetrates to so great a depth as 350 feet below the surface of the globe; also that the statements of M. Arago and Von Buch, and others in our own country, on the increase of temperature in proportion to the distance from the surface, were fully borne out by the observation of M. Schargin, and almost exactly in the same ratio as hitherto found. Captain Back stated, that in his many years' experience in the cold regions of North America, even in the height of an Arctic summer, he had never found the ground thawed more than four feet below the surface; but that experiments on the subject were much to be desired. Edin. New Philos. Jour.

Notice of the Result of an Experimental Observation made regarding Equivocal Generation. By F. Schulze, Berlin.

Since the question respecting *generatio æquivoca* has attracted the attention of naturalists, the development of living organisms has never been observed in vessels from which all air has been expelled by boiling, and which had been hermetically sealed. The access of air has been regarded as a necessary condition for the primary formation of infusoria from decomposing organic matter, so that the mere circumstance of covering an infusion with a stratum of oil, removed that condition. But the question still remained undecided, If the access of atmospheric air, light, and heat to *infundirten* substances, included of itself all the conditions for the primary formation of animal or vegetable organisms? And in this point of view new direct experiments were considered to be very desirable. The difficulty to be overcome consisted in the necessity of being assured, first, that at the beginning of the experiment there was no animal, or germ, capable of development in the infusion; and secondly, that the air admitted, contained nothing of the kind. For this purpose I constructed the apparatus represented in the margin.



I filled a glass flask half full of distilled water, in which I mixed various animal and vegetable substances; I then closed it with a good cork, through which I passed two glass tubes, bent at right angles, the whole being air tight. It was next placed in a sand bath, and heated until the water boiled violently, and thus all parts reached a temperature of 212° F. While

the watery vapour was escaping by the glass tubes, I fastened at each end an apparatus which chemists employ for collecting carbonic acid; that to the left was filled with concentrated sulphuric acid, and the other with a solution of potash. By means of the boiling heat every thing living, and, all germs in the flask or in the tubes, were destroyed, and all access was cut off by the sulphuric acid on the one side, and by the potash on the other. I placed this easily moved apparatus before my window, where it was exposed to the action of light, and also, as I performed my experiments during the summer, to that of heat. At the same time I placed near it an open vessel, with the same substances that had been introduced into the flask, and also after having subjected them to a boiling temperature. In order now to renew constantly the air within the flask, I sucked with my mouth, several times a-day, the open end of the apparatus filled with solution of potash; by which process the air entered my mouth from the flask through the caustic liquid, and the atmospheric air from without entered the flask through the sulphuric acid. The air was of course not at all altered in its composition by passing through the sulphuric acid in the flask, but if sufficient time was allowed for the passage, all the portions of living matter, or of matter capable of becoming animated, were taken up by the sulphuric acid and destroyed. From the 28th May till the beginning of August, I continued uninterruptedly the renewal of the air in the flask, without being able, by the aid of the microscope, to perceive any living animal or vegetable substance, although during the whole of the time I made my observations almost daily on the edge of the liquid; and when at last I separated the different parts of the apparatus, I could not find in the whole liquid the slightest trace of infusoria, of confervæ, or of mould, but all three presented themselves in great abundance a few days after I had left the flask standing open. The vessel which I placed near the apparatus contained on the following day vibriones and monades, to which were soon added larger polygastric infusoria, and afterwards rotaroriæ.

Ed. New Phil. Mag.

Improvements in Magnetical Apparatus. By the Rev. W. Scoresby.

At the meeting of the British Association, held in Bristol, in 1836, the Rev. W. Scoresby made a communication to the Physical Section, on an improved mode of construction in magnetic needles for compasses, &c. by the combination in a parallel series, *not* in contact, of several thin plates of tempered steel. A variation instrument, which he at that time exhibited, constructed on this principle, was stated to have a far greater directive energy than any instrument, of the nature of a compass, previously constructed. Since that period Mr. Scoresby has been pursuing, as opportunity afforded, an extensive series of investigations on the subject; both as to the law of combination in steel plates and bars, and as to the effect of temper, thickness, &c., on the aggregate power; with the view of producing more powerful instruments for determining the delicate variations in, and the actual condition of, the

earth's magnetism; a subject now engaging attention in some of the principal observatories in Europe. The results, which have been successful beyond the objects originally contemplated, have been recently communicated to the Institute of France. One of these results likely to be of much importance in magnetical science, to which it is extensively applicable, is that of producing permanent artificial magnets of almost unlimited power. On the principle of construction of compound magnets hitherto adopted, only a very limited number of bars could be combined with advantage, in consequence of the great deterioration of power occasioned by the condition of violence. Mr. Scoresby found, on combining very superior plates of tempered steel of two feet in length and about $\frac{1}{24}$th of an inch in thickness, that the first six plates received so much power that no additions, however great the number, were capable of producing more, in the aggregate, than about double that power. Aiming, however, to counteract the tendency to such rapid deterioration, Mr. Scoresby made some magnetical combinations of *perfectly hard* steel plates, (which he has a ready method of magnetizing and testing,) by means of which an almost unlimited power can be obtained. Already this combination has been carried, with no inconsiderable augmentation of the aggregate energy to the very last, to the extent of several dozens of hard plates, 15 inches in length, so as to produce, by such combination, a compound magnet of very extraordinary power for its mass. The application of this principle to apparatus for magnetic electricity will obviously be of much advantage for compactness and power; whilst the application of the discovery to variation needles, dipping needles, and, probably, to sea compasses also, promises to be of much importance in experimental science, as well as for practical and economical purposes. Mr. Scoresby's investigations have also led to other practical results, such as the means of testing most rigidly the quality and temper of steel plates, and of bars intended for compound magnets on the ordinary construction, by which the best plates can be selected and the most powerful combinations may be obtained.

Lond. & Edin. Philos. Mag.

Effects of Clearing a Country.

As new facts, proving the influence of clearing a country, in lowering the temperature and diminishing the streams of water, M. Devize de Chabriol communicated to the Academy of Sciences a notice, in which he established that, according to old charters of the 13th and 14th centuries, the slope of the hill Saint Flour was at that time under vine cultivation; he adds that now-a-days its cultivation no longer proceeds. The chesnut, also, has now disappeared from many districts in which it formerly flourished. Hence, numbers of villages which were situated near the summit of the mountains, have been abandoned, and many old springs have also dried up.

Ed. New Phil. Jour.

Simultaneous Meteorology.—No. IV.

TABLE OF HOURLY METEOROLOGICAL OBSERVATIONS, made during the 21st and 22nd Sept., 1837, at Blackheath Road, near Greenwich, about four miles and a half S. E. of London, *by and under the superintendence* of J. H. Belville, in conformity with the Instructions circulated by the South African Literary and Philosophical Institution.

DATE.	HOUR.	Barometer.	THRM. Attac'd.	THRM. In open air.	WIND. Direction.	WIND. Str'gth.	Prop. of Cloud.	STATE OF THE ATMOSPHERE, CLOUDS, &c.
		Eng. In.	F. °	Fah. °				
Thursday, September 21, 1837.	VI. A.M.	29.950	68	51.0	E.	0	5	*Stratus.* Clear in zenith. (The. min. at night, 50.6°.)
	VII.	29.950	68	55.7	E.	0	4	*Stratus* into *Scud.* Sun appears.
	VIII.	29.953	68	57.4	E.	1	9	Sky now covered with fresh *scud* from E.
	IX.	99.958	68	60.0	E.	1	7	*Scud* disperses fast—perfect blue sky.
	X.	29.970	69	62.5	E.	1	3	Clear. A few light *cumuli* scattered to the N.
	XI.	29.972	72	64.0	E.	1	0	Cloudless.
	XII.	29.980	73	65.0	E.	2	0	Ditto.
	I. P.M.	29.980	74	66.0	N.E.	2	1	Ditto.
	II.	29.997	75	95.9	E.	2	0	Ditto.
	III.	29.999	75	65.6	E.	2	0	Ditto.
	IV.	30.000	74	64.0	E.	2	0	Ditto.
	V.	30.018	73	61.9	E.	1	1	A few light masses of *scud* coming up from the E.
	VI.	30.026	71	59.6	E.	1	3	Several groups of low *scud* have passed since the last observation.
	VII.	30.050	70	56.4	E.	1	1	Clouds nearly dispersed. *Dew falls in abundance.*
	VIII.	30.053	69	56.0	E.	0	0	Quite starlight. Cloudless.
	IX.	30.054	69	54.9	E.	0	0	The same. N B. A delicate radiating
	X.	30.056	69	54.0	E.	1	0	The same. thermom. on the ground
	XI.	30.057	69	53.0	E.	0	0	The same. marked 51° at 9 P.M.
	XII.	30.059	69	52.5	E.	0	3	Appearances of fog and mist to southw.
Friday, September 22.	I. A.M.	30.059	69	52.0	E.	0	5	Mist. *Stratus* covers the sky.
	II.	30.058	68	50.6	E.	0	10	Dense dripping mist. Moon invisible.
	III.	30.058	68	52.0	E.	0	10	The same.
	IV.	30.059	68	53.0	E.	0	10	The same. N.B. The *minimum,* by a self-registering therm. 48.9°.
	V.	30.059	68	53.7	E.	0	10	Mist thinner. *Stratus broken in zenith.*
	VI.	20.062	68	54.1	N.E.	0	9	*Stratus* has now become more dense.
	VII.	30.081	68	55.0	E.N.E.	0	7	*Stratus* disperses. Sun shines at intervals.
	VIII.	30.023	68	58.5	E.	1	4	*Scud* moves swiftly from the E.
	IX.	80.103	68	61.0	E.	1	5	No alteration since the last observation.
	X.	30.102	69	62.0	E.	2	5	The same. *A brisk breeze.*
	XI.	30.102	71	63.5	E.N.E.	2	4	*Scud* decidedly receding.
	XII.	30.103	72	64.5	E.N.E.	2	3	Nearly cloudless. Brilliant sunshine.
	I. P.M.	30.100	74	65.3	E.	2	2	The same.
	II.	30.096	74	64.8	E.	2	1	The same.
	III.	30.100	74	64.0	E.	2	1	The same.
	IV.	30.098	73	62.7	E.	2	1	The same.
	V.	30.097	72	61.9	E.	2	0	The same.
	VI.	30.098	71	59.2	E.	2	0	The same.

Notes.—A copious dew before sunrise on 21st. Soon after midnight on the 22nd, a dense fog prevailed for about three hours. The two days nearly clear, with brilliant sunshine, and a brisk breeze from the east. No other modification of cloud than *stratus* and *scud.* A remarkably fine period.

The time was taken from a good clock, keeping mean time. Rate scarcely percep-

Progress of Civil Engineering.

Notice of the life and services of the late M. Sganzin, *Inspector General of Roads and Bridges, and of maritime constructions. Translated from the Annales des Ponts et Chaussées, by* J. Griscom.

Every day sheds some additional light upon the merits of those men who filled high public stations, during the memorable epochs of the Revolution, of the Empire, and of the Restoration, and who have been associated with the vicissitudes and labours of nearly half a century. He who was for a long time the Dean of the Inspectors general of Roads and Bridges,—who devoted forty years of his life to the service of the marine—Joseph Matthew Sganzin,—has just followed to the tomb a Liard, a Cachin, a Bruyere, a Girard, and a Brisson with whom he had honorably shared in a career of usefulness.

He belonged to a family, originally Italian, which removed to France at the conclusion of the wars of Piedmont. He was born at Metz, the 1st of October, 1750.

After completing his studies at the College of Metz, he entered, on the 6th of November 1768, the School of Roads and Bridges, under the direction at that time of the celebrated Peyronnet.

The preparatory education, common to the various public services, since so happily established in the Polytechnic School, did not then exist; and the Special School of that epoch served to complete the scientific studies of the Colleges and to initiate the students in their technical applications.

M. Sganzin, after a seven years novitiate, was appointed assistant engineer on the 1st of April, 1775; a title which corresponded with that of the present ordinary engineer of the second class, of Roads and Bridges.

He made a brilliant entrance upon the active duties of his station, being appointed to lay out and to execute several roads of the greatest importance, through mountainous districts, in the ancient provinces of Rouergue and Quercy; and his labours were so successful and contributed so much to the prosperity of those countries, as to have preserved the memory of Sganzin, with great fidelity among them. The reconstruction of a pier of the old bridge of Cahors, on a foundation of rubble stone mortar, or hydraulic cement (en béton) is also cited as an achievement in one of the most difficult arts of Engineering, and one of the first examples of this kind of foundation.

This success caused M. Sganzin to be appointed on the 1st of August 1785 inspector of Roads and Bridges, a grade since suppressed, and at that time intermediate between a sub-engineer, and an engineer in chief. M.

tible during the observation. Error obtained by observation of the ball drop of the Royal Observatory, Greenwich.

The Barometer has an elevation of 46 feet above *mean high-water mark* of the river Thames, carefully deduced by very accurate barometrical measurement. Makers, Watkins and Hill, London. The index error of scale presumed to be within a *hundredth* or two of the truth. The Thermometer, by Dollond, suspended in open air, at an elevation of 40 feet from the ground, aspect, northerly.

The comparative strength of wind is indicated by the figures thus,—0 means no wind perceptible; 1, very light breeze; 2, strong breeze. In the column headed *Proportion of Cloud,* 0, signifies quite clear; 10, no blue sky visible; 5, sky half covered.

Sganzin was, in that quality, attached to the great works at the port of Havre, under the direction of the late M. Lamblardie who had the principal charge.

A very close intimacy was there formed between these two fellow labourers, increased by the near equality of their ages, by a similarity of tastes, and a community of elevated sentiments.

The several powers which succeeded each other, after the turbulence of the first revolution, appeared to perceive the happy influence, which this intimacy, this identity of views between two able engineers, would have in the public service, and they each sought to turn it to account.

Hence, as soon as Lamblardie, in 1793, had left Havre, where his name will long be attached to the docks and quays which he constructed, he was replaced by M. Sganzin, raised to the rank of Chief Engineer. The latter engaged alone in the work of the great dock of La Barre.

In 1795 Sganzin was called to Paris, at the instance of his former associate, to act as his coadjutor in the council connected with the committee of public works and to take charge of the depot of charts and plans.

Our victorious armies had just penetrated Belgium and Holland, and expelled from thence the Anglo-Russian forces.

The French government charged M. Sganzin and M. Maudar, (chief engineer of Roads and Bridges then in retirement) to explore all the interior and maritime works of Holland, and to study the various systems of execution which had been practised in that country. Unhappily, the valuable collection of designs and notes, which were the fruits of this mission, and which still remains in the hands of the widow of Sganzin, has not been published; the numerous occupations of Sganzin during his active career, always presenting an obstacle to its execution.

He had returned to Paris in 1798 when death, suddenly, and most unexpectedly, deprived him of his friend Lamblardie, in the vigour of age, in the full maturity of his powers, and when the polytechnic school, of which he was one of the founders and professors, and its first director, promised him a noble reward for his labours, by the light and spirit it had begun to diffuse through the nation.

Again, the Directory found it expedient to fill the chasm occasioned by the death of Lamblardie, in the marine service and in the instructions of the polytechnic school, by recalling Sganzin to the fulfillment of these double functions.

He united to this species of inheritance, another still more sacred;—that of becoming voluntarily the adoptive father of the young family which his friend had bequeathed him, and he united forever his lot with the children of Lamblardie, by marrying their mother.

A short time after, in consequence of the descent of the English upon the Belgic coast, and their destruction of the great Dam of Slikens, near Ostend, Sganzin was charged, by a mission extraordinary, to repair this great work, which comprehended two locks for the passage of vessels of different sizes. He succeeded in less than a year in restoring a safe commercial intercourse with a port, important for its facilities in connexion with the channel.

In the following year (1799) Sganzin received a still more important order,—that of organizing the maritime operations and establishment of the New Dock Yards at the port of Antwerp.

The consulship had just been erected on the ruins of the Directory, and the new Ceasar, in his avidity for all kinds of glory, was full of

plans for public monuments, and extensive works for the defence and riches of the nation, which might hand down his name to the latest posterity, as the monuments of ancient Egypt, which he had recently conquered, had been destined to transmit those of their founders.

His fertile genius reorganized the administration of Roads and Bridges, and instituted a council for maritime operations, composed, at first, of three members, and to this service he appointed Sganzin, Cachin and Ferregeau, still continuing their participation in the deliberations of the general assembly of Roads and Bridges, of which the chief engineers at that period formed a constituent part. On entering upon these new duties, M. Sganzin had to remodel the service of the naval depots in the ports placed under his administration.

An energetic impulse was given, at once, by the first consul, to extensive undertakings on the public roads, internal navigation, bridges, and the commercial and military ports of France, within its enlarged boundaries.

Napoleon entered, himself, into the profoundest questions of art and skill which his vast projects involved, with those select few whom he had distinguished in the various public services. Sganzin was then brought to share in the marked confidence and benevolence which the Emperor constantly bestowed upon his confidential advisers.

A circumstance occurred, which, though trifling in itself, serves to exhibit the ardor with which the genius of Napoleon engaged in the planning of his great public projects. One evening, after dinner, at the camp of Boulogne, he sent for M. Sganzin, to ask him some questions relative to a scheme on hand; after detaining him several hours, Napoleon perceived that his interlocutor appeared fatigued, and he soon learned from him that he had been long fasting. He immediately rang the bell, ordered in a supper for M. Sganzin, and while the latter was recruiting his strength, he continued to discuss the subject with him and write, in some sort, under his dictation.

It was the Emperor's habit also to request his officers to send him the rough sketches, and first draughts of the memoirs and reports which he had asked them to prepare, both that he might the better judge of the capacity of his agents, and seize the first impressions of their minds, and thus form his opinion, from the aspects under which the subjects had at first been viewed.

It was not long before Sganzin was promoted to the highest grade in the corps of Roads and Bridges; a decree of the consul, of 30 messidor, year 11, (19th June, 1803,) appointed him "inspecteur general des Ponts et Chaussées," and a few months after he was decorated with the legion of Honour.

Sganzin immediately, but in vain, claimed of the Emperor, the same promotion for his colleagues, Cachin and Ferregeau.

From that time Sganzin was directed to accompany Napoleon in all his journeys along the coasts of the empire, and received from him the most important commissions, sometimes alone, and sometimes with the illustrious academician whom the deep sagacity of the King has just called to the peerage.

It was thus that M. Sganzin had to organize in 1804 and 5 all the works at Boulogne and other places on the channel, during the projected attack on England; and he was subsequently associated in all the great plans of the Emperor at the ports of Antwerp, Flushing, the Helder, Niewdiep and various other points in Belgium and Holland.

In a first journey to Italy, in 1805, with de Prony and Sanè, Sganzin prepared, in conjunction with them, the vast plans which the Emperor had conceived for the improvement of the forts of Genoa and Spezzia.

He had scarcely finished this mission when he had to repair to Belgium to preside over the enlargement of the great dock at Flushing, the execution of which was confided to M. Boistard, then chief engineer of maritime works, and M. Lamblardie, his son, engineers in ordinary. In less than a year, and at a moderate expense, this great hydraulic achievement gave passage to ships of the line, by the employment of an entirely new system which will probably find frequent applications in great commercial seaports, when it becomes necessary to adapt them to the dimensions of steam ships.

A second mission to Italy in 1806, in which M. Sganzin was connected with de Prony, was for the purpose of raising from its ruins the ancient port of Venice, which had been the cradle of modern commerce. Eventually towards the close of 1807 he accompanied the Emperor to Venice, and was charged with the exploration of various ports of the Adriatic, of Friuli, and of Illyria.

Scarcely had the French flag penetrated into Spain, in 1808, before the eagle eye of Napoleon was turned to the ports of his new conquest, and it was again de Prony and Sganzin that received orders to examine all the ports of the coast from Bayonne to St. Sebastian, and to collect materials needful for the arrangement of the projects which the Emperor had formed. The vicissitudes of our arms and other political engagements in the East and North of Europe prevented the execution of the views of Napoleon upon the Spanish ports.

These distant missions,—a participation in the discussions of the council of maritime works and in those of the general council of Roads and Bridges,—journeys in the suite of the Emperor, into Belgium and Holland, in 1809—11,—and special excursions to some ports of France, did not interrupt the course which M. Sganzin gave in the polytechnic school, and as early as 1807 he had orders to publish, hastily, his instructions in a substantial form. This work, under the modest title of a *summary* (Resumé) has been long the almost sole guide of the pupils of the polytechnic school, scattered throughout the various ranks of the public service, and having reached a fourth edition, it still remains to be justly in favour with the public.*

In 1812 the course of the polytechnic school was suppressed, from considerations of economy, and M. Sganzin obtained a pension of 3000 francs which was reduced in 1818 to 1900 francs. He took no part of this grant during the whole time he was in active service.

The malevolent jealousy which the confidence of Napoleon had excited against him, succeeded at length in diverting the favour of the Sovereign: the Emperor was induced to believe that Sganzin was in possession of a great landed estate, and that he was very rich, notwithstanding the evident falsehood of such absurd allegations.

At the restoration, Sganzin was found to be simply a member of the legionary corps. He was invested by the King solely, with the general inspection of all the naval depots except Cherbourg, he was nominated an officer of the legion of Honour, in 1814, and afterwards in 1819 on the proposition of M. Portal, then Minister of Marine, he was created Knight of the order of St. Michael.

*A translation of this work, from the 3rd French edition, was published in Boston, in 1826, and is used as a text book in many of our schools. Trans.

At this new period of his life, Sganzin, who had attained the age of 70, still retained his wonted vigour of mind and body. Frequent tours of examination among the ports,—a journey to England, relative to the suspension bridges purchased for the Island of Bourbon, in which he contracted an amiable alliance with the celebrated Brunel,—an investigation of the projects formed for the restoration and enlargement of the ports of old France, neglected during the latter years of the empire, did not prevent him from participating in the deliberation of the general council of roads and bridges, and of the joint-committee of public works and light houses.

The death of Cachin in 1824 placed M. Sganzin, in the sole authority of the Marine depots, by reassigning to him the port and harbour of Cherbourg.

At the close of the same year he was appointed a member of the committee of consultation of naval depots, recently created, and shortly after he became its President by age and rank, which he held till 1831, when this commission was replaced by the existing council of which he continued to be a member.

The gradual failure of his memory and other faculties prevented him, in the latter years of his life, from taking an active part in the various services which had so long engaged his attention. Agreeably to his wishes the son of his former friend, now his own by adoption, was connected with him as adjutant inspector, and succeeded him in April 1835, when the King, by appointing M. Lamblardie inspector general of roads and bridges, made the most agreeable provision for the preservation of the titles and comforts of the family. The Cordon of the Legion of Honour, was the last reward conferred on M. Sganzin, on his retirement, at the age of 87, after 62 years of efficient service.

From the time of his retreat, to the 10th of January 1837, the day of his decease, Sganzin's memory, except at intervals, appeared to be almost obliterated. He died at Bougival, near Marly, surrounded by the pious attentions which had been devoted to him for nearly 30 years, leaving to his adopted family only the inheritance they had received from their own distinguished father, and the honorable memory of a life unremittingly devoted to his country and his duties.

Sganzin left two nephews of the same name, whom he had educated at his own expense, who, following his example, became attached to the public service, in which they both, at present, count long years of honorable activity, the one a marine engineer, and the other as an officer of artillery.

The public functionaries of every rank and department, with whom M. Sganzin held any relation during this long career of 62 years service, commencing in 1775, bear united testimony to the uprightness of his intentions, to his talents, and to the sagacity of his judgment, enlightened by long experience. The engineers who served under his orders, will never forget, that, under an apparently formal exterior, he cherished the warmest benevolence, the most earnest desire to assist them under all circumstances, to defend their interests, and to procure for them the rewards of which he deemed them to be worthy.

Annales des Ponts et Chaussées 1837.

A Summary view of the Progress of Architecture in Britain during the past Year; with some Notices relative to its state in Foreign Countries. By J. C. Loudon, F. L. S., &c.

The year 1837 scarcely affords any marked feature of architectural

progress, such as the competition for, or completion of, any great national work; but it exhibits what is much more satisfactory, a general spirit of architectural improvement in the metropolis, throughout Great Britain, and, to some extent, even in foreign countries.

In London, there is scarcely a principal street that does not exhibit some new architectural feature; public institutions and companies, and even eminent commercial houses, being alike eager to attract attention by an improved architecture without, no less than by superior arrangements within. These kinds of improvement have been going on, more or less rapidly, since the peace of 1814; and the former appears to have received a considerable stimulus, a few years ago, from the general rage for ornamenting the fronts of gin shops and public houses. Most of these buildings, indeed, exhibit very inferior specimens of design; but, as they have advanced a step beyond what had gone before in the same kind of houses, they ought not to be despised; and however common it may be for architects to laugh at the splendour of gin temples, yet it cannot be denied, we think, that to them the architects and architecture of the metropolis are considerably indebted. Among the buildings of public companies may be included the club houses, bazaars, insurance offices, and banking houses; and, among these, we may point to the Oxford and Cambridge University Club-house in Pall Mall, the Pantheon Bazaar in Oxford street, and the Atlas Fire-office in Cheapside, as very handsome public ornaments. The Pantheon is deservedly admired for its interior arrangement and decoration, and the Fire-office for its exterior elevation. Among public institutions may be noticed the Surgeons' Hall in Lincoln's Inn Fields, and the City School in Wood street, Cheapside; and a number of other schools, together with various churches and chapels, might be enumerated, if the object were to do more than take a cursory glance at general features. The New Palace at Pimlico has this year been taken possession of by Her Majesty, and the New Houses of Parliament commenced.

Throughout the country, architectural improvement is general. There is hardly a large town in which some church or school has not been recently erected. New markets or town halls are completed in some places, and in progress in others; and public cemeteries and cemetery chapels are increasing every year. Perhaps the best markets completed during the past year, are that at Exeter, by Mr. Fowler, and that at New Castle, by Mr. Grainger. The town in England which is, perhaps, undergoing the greatest architectural improvement is, however, Newcastle, where Grey street promises to be, when completed, one of the handsomest streets in England.

On looking over our Provincial Notices, under the heads of Scotland and Ireland, evidence will be found that architecture is not stationary in these countries, though we cannot point to any particular feature in either which characterises the year 1837.

Among foreign countries, France appears to take the lead. Munich and Berlin may be considered as next in the order of architectural ameliorations; but Belgium, Russia, and even Greece, Italy, and Spain, might be cited in evidence of improvement. The state of architecture in the United States is noticed; by which it appears that banking houses, hotels, and theatres are erecting, with an increased regard to architectural effect.

If the progress of architecture in Britain is considerable, that of engineering may be considered as extraordinary. The railway between Birmingham and Liverpool has been opened in the course of the year, and the following railways are in progress:—the London and Birmingham railway, which is already opened as far as Tring, and which will probably be completed in 1839; the Southampton railway, which will probably be completed about the same time; the Great Western railway, the works of which are far advanced; and the Eastern Counties' railway; the Northern and Eastern railway; the Croydon, Greenwich, and Brighton railways; and the London Junction railway, which are all more or less in progress. The works in the Thames Tunnel, that very remarkable undertaking, which, now that the company has received the assistance of government, may be considered as national, are going steadily forward, though occasionally interrupted by irruptions of the river.

The architectural literature of the year includes the *Transactions of the Institute of British Architects*, and the *Transactions of the Institution of Civil Engineers*, both of which contain many valuable papers; several pamphlets relative to the new Houses of Parliament, which contain some interesting discussions; The Report from the Select Committee on Arts and their connexion with Manufactures, which indicates an increased attention to these subjects on the part of government; a translation, with notes, of *Vicat on Mortars and Cements*, a work which was much wanted; and a *Lecture on the Dry Rot*, by Dr. Dickson, which contains information respecting the Kyanising process, well deserving the attention of builders, who, in general, do not seem to understand the mode of its application. Among the articles in the present volume of this Magazine, the two which we consider the most valuable are those by Dr. Ure and Mr. Richie, on Warming and Ventilating. For critical remarks, those of Candidus are highly instructive; and there are many papers of a practical nature, by other writers, not less so.

Architectural Magazine.

Formation of a School of Design in Manchester.

A short time ago, a number of gentlemen of this town, sensible of the importance of a school of design in this great emporium of arts and manufactures, assembled and formed a provisional committee for the purpose of taking the steps necessary to originate such an institution. At first it was contemplated that it should be a branch of the recently founded school of design in the metropolis; but much disappointment was experienced on finding that there the mechanics were debarred from an equal share in the privileges and studies of the school, and it was ultimately determined that the Manchester School of Design should be a wholly separate and independent institution. At a general meeting of gentlemen favourable to the establishment of a school of design in Manchester, convened by the provisional committee, an animated debate took place; James Heywood, Esq., chairman of the provisional committee, presided, and opened the proceedings. In the course of an excellent speech, he stated that from time to time many efforts had been made by individuals to improve the fine arts in Manchester by their own exertions, and he thought great praise was due to those persons; but very little had hitherto been done by any public body, for the improvement of the arts of design. The Mechanics' Institution had come forward

more directly than any other body, having formed classes in several departments of design; as mechanical, architectural, flower, figure, and landscape drawing; and in 1835, the class for mechanical and architectural drawing had an average attendance of 33 pupils; and that for landscape, flower, and figures, of 64 pupils. He hoped these classes would continue to prosper; but what was now wished to be effected was, the formation of a society having for its sole and peculiar object to improve the arts of design, an object sufficient to occupy the whole time and attention of a society with reference to the improvement of those manufactures in which design is required; and also in the education of persons to direct the mechanical powers of this great community. Elsewhere such objects were thought of great importance. Lyons, which rivalled Manchester in many respects, and exceeded it in the taste of its inhabitants in design, had regular schools of design, in which particular attention was paid to the departments of flowers and ornamental drawing. When at Lyons, some years ago, he had obtained an account of the subjects proposed for prizes in an exhibition, where prizes to the amount of £20 or £30 were given for drawings and paintings. Those subjects were:—coloured drawing, including ornaments, figures, and flowers, in the same composition; groups of coloured flowers; selections of plants, drawn after nature, slightly shaded, of the natural size; the plants separated, so as to exhibit the principal details of flower and foliage under different points of view, not as botany would require them to be exhibited, but as they would be considered most beautiful in art.

Mr. T. W. Winstanley read the following report of the provisional committee:—

"The diffusion of knowledge, in whatever department of science it takes place, is a subject of great interest to every lover of public improvement; and the formation of a school of design, in the town of Manchester, must tend to its commercial, as well as classical, prosperity, and must also prove beneficial to the inhabitants of the surrounding towns.

"Manchester, as the great emporium of human industry and production, creates within herself a considerable demand for the decorative and ornamental departments of design, in the operations of calico printing, fancy weaving, and embroidering. Individuals employed in these branches of art require an institution for the improvement of taste, and for the encouragement of harmonious conceptions in beauty and form. Such an institution is equally requisite for students in civil engineering, to whom precision of design, and the skilful use of instruments, in surveying, planning, &c., are essentially necessary in their professional pursuits.

"It has been well remarked, by the Baron Charles Dupin, in his advice to manufacturers, and to the foremen of workshops, that the only efficient means to encounter competition is, to manufacture goods really better than all our competitors.

"Superiority in manufacture depends, in a great measure, on the fortunate exercise of taste, economy, industry, and invention. The establishment of a school of design, in Manchester, is recommended, in order to enhance the value of the manufactures in this district, to improve the taste of the rising generation; to infuse into the public mind a desire for symmetry of form, and elegance of design; and to educate, for the public service, a highly intelligent class of artists and civil engineers.

"Impressed with these views of affording encouragement to the cultivation of the arts of design in Manchester, the present meeting has been called, in the confident expectation, that a society will now be formed for

that object, and that the patronage of this influential and wealthy community will not be wanting to the successful execution of a plan which promises so much advantage, both to individuals and to the public."—*Manchester Guardian, Feb.* 21, 1838. Ibid.

The Thames Tunnel.

The engineers of this great undertaking have again succeeded in recovering possession of the works at the Tunnel. The usual means were taken to stop up the aperture in the bed of the river which led to the late irruption. The shore engine was set to work on Friday, and on Saturday afternoon the water had been pumped out of the shaft to the extent of six feet below the crown of the arches of the Tunnel. It is confidently expected that the works will be resumed again in a few days.

April 11, 1837.—Mr. Brunel gave an account of the Thames Tunnel. Having described the nature and difficulties of the undertaking, and the previous attempts which had been made by others to effect a similar work he explained, by reference to sections, the nature of the strata below the river. He had adopted the rectangular form of the present excavation, because the work would set better than if of any other form, and had a better sustaining surface. The necessity of supporting the ground, and of having a sufficient shelter, had led to the adoption of the shield, respecting which so much had been said. The construction of this would be understood by conceiving twelve books set side by side on their ends. These would represent the parallel frames which, standing side by side, but not in immediate contact, fill up the excavation. Each frame is divided into three boxes or cells, one above the other; the adjustment of the floors of which, and other details, were minutely described by Mr. Brunel.

Each frame is furnished with two large slings, by which it may derive support from, or assist in supporting, its neighbours; it has also two legs, and is advanced as it were by short steps, having for this purpose an articulation which may be compared to that of the human body. The frame rests on one leg, and then one side is hitched a little forward; then resting on the other leg, the other side is hitched a little, and so on. Hence the shield may be called an ambulating coffer-dam, going horizontally.

The brick-work is built in complete rings, and the advantages of this system of building had been fully proved by the fact of two dreadful irruptions having produced no disruption. Such was the violence of the irruption, that the brick-work had in one part been suddenly reduced in thickness by one-half, and in one place there was a hole as if pierced by a cannon ball. At a few feet beneath them is a bed of quicksand fifty feet deep, and above them strata of most doubtful consistency, some of which goes to pieces immediately on being disturbed. Still however, their progress is certain, and they only require patience to allow of the ground above them acquiring sufficient density. He found gravel with a mixture of chalk or clay extremely impervious to water; in some cases he contrived to let out the water from the sand above them, and thus obtained ground of sufficient density. In their pro-

gress they were considerably annoyed by land springs, which produced cutaneous irruptions, and destroyed the finger nails of the workmen.

April 18, 1837.—Mr. Brunel gave further explanations respecting the Tunnel. He explained the way in which the ground above them had suddenly sunk down, owing to the run of a lower stratum of sand. This running sand, which was a very great annoyance, consisted of *five* parts water and *one* sand. Bags of clay and gravel are not best where there are many stones; for the interstices do not become properly filled up; but, in these cases, the coarsest river-sand is best; the water runs through at first, but soon stops; gravel and clay mixed are nearly impervious to water, but not so impervious as gravel and pounded chalk.

Mr. Gibb stated that he had found bags filled with clay and tow-waste exceedingly impervious to water. Being called upon to rebuild a sluice in a place where piling, owing to the stony nature of the ground, was impossible, he had formed a coffer-dam by laying down bags full of clay and tow-waste, in tiers of four, formed on the top of each other to the surface of the water.

The ventilation of the Tunnel is effected by a pipe of fifteen inches square, passing out under the fire-place of the steam engine boiler.

Repert. of Pat. Inven.

Transactions of the Institution of Civil Engineers.

"*Result of experiments made with a view to determine the best figure and position for wooden bearers, so as to combine lightness and strength; by* James Horne, F.R.S.; A. Inst. C.E."

The results of several experiments on wooden bearers of different sections are tabulated; together with the dimensions and weights of the pieces, and the nature of the fracture. The conclusion at which Mr. Horne arrives is, that a triangular prism placed with its base upwards is the strongest figure and position, that with an edge uppermost, the weakest, for a given quantity of material.

Vibrations of the soil from the passing of Locomotives, &c.

The subject of the vibrations produced in the soil by the passage of locomotives and coaches was discussed and several instances were mentioned, in which the vibration of the soil was sensible at the distance of a mile and a half during an observation by reflexion. It was stated that the experiments recently made for determining the effect which the passage of the locomotives at a small distance might have on the observations at the Royal Observatory, had not been conclusive; but that as no sensible effect could be produced on any observations but those by reflexion, no apprehension of inconvenience was entertained.

It was also stated that a number of persons running down the hill in Greenwich-park produces a slight tremor, which is quite sensible during an observation by reflexion, and that the shutting of the outer gate of the Observatory throws an object completely out of the field of the telescope.

The comparative merits of the single pumping and the crank engine for the purpose of raising water, were discussed.

Mr. Simpson stated that it was a generally received opinion that a single pumping engine would do one-third more duty than a crank engine; but that having recently had a crank engine altered by Messrs. Mudslays and Field, and fitted with expansion valves, it did the most duty.

The two engines were worked from the same boiler. The duty of the crank engine was about thirty-two millions; it works to a fixed lift, which is in some respects advantageous. The duty of the Cornish engines is reported at ninety-five millions; and an engine near London, in which the Cornish valves and system of clothing had been adopted, was doing a duty exceeding fifty millions.

With respect to the Cornish engines, it was stated that their superior duty was due to the system of clothing; that although many persons had examined their duty, the calculations appear to be made from the contents of the working barrel; that the Cornish bushel is 90 or 94 lbs. of very superior coal; the London bushel being only 80 or 84 lbs.; that, notwithstanding the great duty done by the pumping engines, the engines in Cornwall are doing less duty than the crank engines in London.

"*Notice concerning the Thames Tunnel;* by Richard Beamish, M. Inst. C. E."

Several attempts have been made in former years to effect a communication betwixt the opposite shores of the Thames by means of a tunnel, all of which, however, failed. In 1798, Dodd proposed a tunnel at Gravesend; and in 1804, Chapman proposed one at Rotherhithe; and in 1807, Vazie commenced the construction of a shaft, eleven feet diameter, at a distance of 315 feet from the river. With Vazie was associated Trevethick, a man of great practical knowledge as a miner; and by indefatigable labour, a drift-way, five feet in height, two feet six inches in breadth at the top, and three feet at the bottom, was carried 1046 feet under the river. In the spring of 1808, having first ascended from under a rocky stratum, though with a depth of at least twenty-five feet betwixt them and the bed of the river, the Thames broke in upon them, and not a single brick having been laid, the work was irretrievably lost.

In 1823, the subject of a tunnel was again agitated, and a company was formed to carry into execution the plans of Mr. Brunel. The first proceeding was to sink a shaft. Twenty-four piles, with a shoulder on each, were first driven all round the circle intended for the shaft. One side of a wooden platform, or curb, was then laid on this shoulder, whilst the other side rested on an iron curb, having an edge below to which it was attached. Through this curb, ascended forty-eight wrought iron bolts, two inches in diameter, to the height of forty feet, the height to which it was proposed to raise the shaft. The regular building of the tower on the curb, with bricks laid in cement, was proceeded with, and yet farther bound together by twenty-six circular hoops of timber, half an inch thick, as the brick work was brought up. At the top of the tower was placed another curb, and the long iron bolts passing through it, having their ends formed into screws, the whole was screwed solidly into one mass, and completed in three weeks. In a week after it was finished, sixteen of the piles having been driven, two by two, opposite each other, the whole structure was sunk half an inch, carrying down with it the remaining eight piles, on which it was brought to

a rest uniformly and horizontally, thus permitting the sixteen piles to be abstracted by opening the ground at the back. The whole weight supported by these eight piles, was about 910 tons, (the weight of the shaft.) Having been left for three weeks to dry, and gravel having been heaped under the curb, the remaining eight piles were removed, two by two, till the mass rested on a bed of gravel. The machinery, viz: the thirty-horse high-pressure steam engine, with gear for raising the excavated soil, was now fixed on the top. The miners were placed inside, and by excavating from around the bottom, the whole descended by its own gravity.

Mr. Beamish then describes the peculiar difficulties which were experienced previous to the first irruption.

The chasm in the bed of the river, formed by the irruption of 1827, was stopped by bags filled with clay, with hazel rods passed through them; and the interstices filled by gravel. The irruption of 1828 was met by similar means, but the funds of the company not being then sufficient for proceeding with the work, the shield was blocked up with bricks and cement, and a wall four feet in thickness was built within the tunnel.

For seven years the work was abandoned, till, in 1835, a Treasury loan was granted, subject to the condition that the most dangerous part of the tunnel should be executed first. On resuming the works, the first object was to provide a drain for the water from the shield, for which purpose two reservoirs were formed under the middle pier, from which drifts were formed to the bottom of the great excavation shield. The water was abstracted from the shield at the lowest point, and the pipes of two pumps worked by the steam engine, being brought into the reservoir, all the difficulty of the drainage was overcome.

The removal of the old, and the introduction of the new, shield, was a work of no ordinary difficulty. The bricks and cement had, by the strong oxide of iron which the water contains, been converted into a mass harder than most rocks; and not less than 1646 feet of surface, 342 of which constituted the ceiling, had to be supported on the removal of the brick work previous to the introduction of the new shield. The means, however, adopted by Mr. Brunel, and which were described in the paper, were pertectly successful. Lond. Journ. Arts & Sci.

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*On Pumps used in Mines.** By John Taylor, Esq., F. R. S., &c.

The extent to which pumps are used in England for the drainage of mines, which would be inaccessible without them, renders all information upon the subject important, and every thing that may conduce to their perfection worthy of regard; as the metals are exhausted from such places as are capable of being laid dry by levels, recourse must more and more be had to means for raising the water, which presents so formidable an obstacle to works which have not only to surmount this difficulty, but many others, which try the skill and patience of the miner.

The vast produce of copper in Cornwall is chiefly raised from depths far below the level of the sea; and those depths are securely and uninterruptedly drained by the application of the enormous power of many steam engines lifting great columns of water in the way I have pointed out.

At the Consolidation and United Mines, the aggregate power of the steam

*The "Mining Review and Journal of Geology," by Henry English, No. VIII, from which this extract is taken, contains three large plates, descriptive of the structure of pumps used in draining mines. G.

engines for pumping is nearly that of 2,000 horses, constantly working; there are, altogether, seven, of which four are of the largest class ever erected, having cylinders of ninety inches in diameter, with a stroke of the pistons of ten feet, the first engine ever constructed of this dimension being erected for this mine, by Mr. Woolf. The pumps are generally of sixteen inches diameter, and the whole length of the column lifted is nearly 800 fathoms, divided into lifts of about thirty fathoms each; the quantity of water discharged into the adit level is, when the engines work at the rate of eight strokes per minute, more than 38,000lbs., or above 100 barrels delivered in that time.

But the largest quantity of water lifted by pumps from mines in this country, is at the Mould Mines, in Flintshire, where the power applied is derived both from steam engines and overshot water wheels; of the former, there are seven, with cylinders from thirty-six to sixty-six inches diameter; of the latter, four of forty-four feet diameter each. The pumps are of extraordinary dimensions, being from twenty-two inch bore to ten inch, but the principal part of eighteen inch, reckoning always the diameter of the working barrels, or the plunger poles. Fifteen lifts discharge into the different adits, and often deliver more than 80,000lbs. of water per minute, from a depth averaging about fifty fathoms.

Mines circumstanced as these and many others are, must depend upon well arranged machinery to permit their being worked; and we owe to steam engines, and the improvements in them, which have rendered their use economical, the access to many of those stores of the metals in this country, which not many years ago were sealed up and could not be approached. Some progress has been made in applying the same means to drain the deep mines of some parts of the New World, where heretofore animal power alone was employed in the manner which could only be effective at a great expense, or where the volume of water to be removed was inconsiderable, compared with that which is raised by pumps. An increasing interest will attend the subject of this communication, as it is more extensively called into use, and as greater depths are attained requiring the greatest perfection in design and execution, and this will be my apology for this slight attempt to describe the present state of this important branch of mining apparatus.

Mining Rev.

The Railway System.

The present period forms an era of much importance in the progress of the railway system, and more so, perhaps, in reality than in appearance, as we shall presently have occasion to show. It is often difficult indeed correctly to appreciate those important changes which are constantly altering the aspect of society, while they are yet slowly passing before our eyes, their real magnitude and effects obscured by prejudice or other temporary causes.

The excitement of 1835 has, doubtless, had a vast and permanent influence on the railway system, both beneficial and prejudicial; its effects were beneficial in many respects, as it first brought this mode of communication before the public in that prominent and conspicuous point of view which its extraordinary merits and utility demanded, thus attracting that vast amount of capital to this new mode of investment, without which no effectual progress could be made. Extensive undertakings were projected and put in execution, which, at any other time, would long have remained dormant and neglected, while the talent of numerous individuals received a power-

ful impulse towards a costly, but as yet almost infant art, in which there was ample scope for its display. On the other hand, however, evils of no small magnitude were incurred—speculation, once aroused, was not nice in its choice of objects, and the visionary scheme, which existed merely on paper, or in the minds of fraudulent or misguided parties, met with too ready and indiscriminate a reception from the public generally, while premiums, often extravagantly high, were lavished without thought or judgment upon every concern which was ushered into notice. Apprehension and disgust soon followed—individuals lost their money, and railways lost their character; nor need we call to mind the long season of difficulty and depression which thence ensued.

Had the railway system rested on no good foundation—had it not been characterised by an inherent soundness, and ranked as one of the greatest and most beneficial inventions of the present wonder-working age, it would long have lain dormant after so terrible a reaction, nor should we now, or on several late occasions, have been called upon to notice its returning hold upon the public mind. The case is, however, different—railways have struggled through the temporary difficulties by which they were surrounded, and are now looked upon with scarcely less interest than at the period to which we have just referred, although experience has fortunately sobered down extravagant expectation, and, to a great extent, checked the farce of exorbitant premiums.

If we examine the actual state of railways, or of railway works at the present time, the contrast with any former period must be most gratifying, as the reports furnished weekly in our columns will, in most cases, tend to show. Stupendous works, which, a year or two ago, were hardly traced on the ground, are now either completed or verging towards completion. Enormous sums, the practicability of raising which was then almost a matter of doubt, have been forthcoming, notwithstanding all the difficulties of the times; and what is even more gratifying, the profitable results of railway investment have received the most satisfactory of all confirmations—that of increased experience.

Mining Journal.

Experimental Brick Beam.

Messrs. Francis and Sons, the Roman cement manufacturers, at Nine Elms, some time ago erected what is termed a "Brick beam." This beam was composed of 19 courses of gray bricks, cemented together with the best Roman cement instead of mortar, and having in some of the courses hoop iron placed horizontally. The length of this beam was about 24 or 25 feet, the ends resting on upright gables or pedestals. The width of the beam was two bricks and a half, placed lengthwise. The purpose was to show the efficacy of the Roman cement by its adhesion to the hoop iron as well as to brick, and its consequent adaptation, at a comparatively small expense, to many purposes where an arch could not be so conveniently used, such as railroads, &c. For some time past a weight of iron, amounting to nearly 11 tons, has been suspended by chains over the beam, and it has stood firm and unmoved. Messrs. Francis resolved, on Wednesday, to test to the utmost the strength of their contrivance, and commenced at half-past twelve o'clock gradually to increase the weight attached to the chains. At half past two o'clock the weight suspended across the beam was upwards of 22 tons, and at that time the pedestals began to diverge a little outwards, and in a moment afterwards the beam broke across at the place where it was

traversed by the chains. The rent, or break, was almost as clean as if cut with a knife; there was no crumbling of the cement, nor did the bricks separate from their interstices, the whole fracture was as if a piece of solid rock had been suddenly divided by some irresistible power. As far as the goodness and efficacy of the cement were concerned, the experiment was perfectly satisfactory. There can be no question that a beam of this sort may be made available for many purposes; whether or not the rumbling of carriages over bridges built on this principle, or on a viaduct, would, by the vibration, cause any alteration in its stability, remains, perhaps, to be proved. From what was seen yesterday, enough was proved to evince the very superior tenacity of the cement, and to show that an important improvement has been introduced at a very low rate of additional expense.—*Times.*

Lond. Mech Mag.

Mechanics' Register.

European Lead Mines.

The vast supply obtained from the deposites of lead ore existing in the range of mountains called the "Sierra de Gador," in the province of Grenada, has had, for many years past, a very material influence upon the lead mines of England, and was the cause of that severe depression which, for a time, almost threatened to annihilate this branch of mining industry. The produce of lead from the mines of Great Britain amounts, on an average, to about 45,000, or from that to 46,000 tons annually, being a production very far exceeding that of any other country—and to which, indeed, that of Spain alone bears any proportion. The above produce of lead is greatly beyond the amount required for home consumption—thus leading to a very large export of this metal, amounting, previous to the effectual working of the Spanish Lead Mines, to between 16,000 and 17,000 tons per annum, or rather more than one-third of the whole produce. The Spanish Mines appear to have been called into activity by the excessively high price of the metal which prevailed in the year 1825; and their produce, which was not before very considerable, soon amounted to about 20,000 tons per annum—the Government having been prevailed upon to relax from its former principle of not allowing the exportation of mineral produce. Under this new regulation, a large portion of this produce soon found its way into those markets which had previously been supplied by England, and thus lessened the usual demand to such an extent as to produce a frightful depreciation in the price of the metal. This state of things continued for several years: the produce of the Spanish Mines soon increased to about 27,000 tons per annum, which may be considered as their maximum; and although less productive latterly, the large quantity exported has still had a very injurious effect on the price of the metal, and more especially, for some time past, when, from the general stagnation of commercial affairs, the demand has been small, and the price rapidly declining.

These restrictions rendered it imperative for the mines to be entirely closed for the space of one year, no other operations being permitted than those necessary to realise the produce now on the surface. The present produce of the Spanish Mines is estimated as exceeding 22,000 tons per annum; but for the next twelvemonth will not probably amount to more than 3,000 tons—a reduction so considerable that it cannot fail to be generally felt, and consequently to have some effect in raising the price of the metal.

Mining Journal.

Hydro-Pneumatic Telegraph.

We have seen a model of a telegraph invented by Mr. Rowley, Surgeon, Royal Navy, of Grosvenor-street, Charlton-on-Medlock, which possesses the merit of novelty, at least, if not, efficiency. It consists of a number of lead pipes, of from a quarter to half an inch bore, each connected at one end with an air receiver, inverted in water like a gasometer, and each having a separate stop-cock; the other end of each pipe being immersed in an eight-ounce white glass bottle, three-fourths full of water. The pressure on the air in the receiver, of course, propels a stream of air along any pipe of which the tap is so turned as to admit air; and the effect of this is an instantaneous bubbling of the air at the extremity of the pipe, as it escapes through the water in the bottle. The pipes in the model are about ten feet in length; but the inventor has tried an experiment with a length of the same piping, extending (in coil) to the length of four hundred feet; and simply blowing into one end of the pipe, the bubbling in the water was produced at the other almost instantaneously. It is obvious, that, the pipes always containing air, any quantity suddenly forced in at one end must produce a concussion which is transmitted with great velocity through the whole length, and the same quantity of air must be expelled at one end as is thrown in at the other. The details of the adaptation of this principle to telegraphic purposes are perhaps scarcely matured in the consideration of the inventor; but the following will be found to be the principal points. Six pipes so prepared and marked at each end in this way:—

*	A	B	C	D	E
	1	2	3	4	5

The one marked with an asterisk or star, it is proposed to use as the preparatory signal, to call attention at the other terminus, and also a stop between each word or signal. The permutations and combinations of the five letters alone would form a tolerably copious stock of signals; but these might be extended immensely by a variety of well-known contrivances. With respect to the cost of a telegraph of this kind, it is clear that the pipes would form the most considerable item. Lead piping of sufficient bore could be supplied, we believe, at something more than £20 a ton: and of this piping a ton weight would make a mile in length. In application, for instance, to the Liverpool and Manchester Railway, each pipe would cost £600, or £3,600 for the six pipes, and the whole cost of such a telegraph for that distance would not be more than £10,000. The inventor has little doubt that a communication could be made to Liverpool, and an answer received in Manchester, in a few minutes, and quite as easily by night as day, if that were necessary. This telegraph would not need to be attended by any scientific person; any one of ordinary intelligence would be capable of managing it, and transmitting any desired communication. At present the model is only constructed to work in one direction; but it is very obvious, that by having double terminations to the pipes, they may be made to convey intelligence in either direction. We must confess we are rather sceptical as to the accurate working of a telegraph on this construction between any two distant points, as for instance, between Manchester and Liverpool. Perhaps if the pipes were quite perfect in their whole length—free not only from fissures, but from irregularities at the joints—the impulse given at one end might be communicated with tolerable certainty and exactness at the other; but we imagine it would be somewhat difficult to lay thirty miles of pipe that would be free from such imperfections, and they would, in all probability, very seriously affect the result. We con-

ceive that along a very good pipe the impulse would proceed in much less time than along a bad one, so that the signal made at the first, might arrive before the second, and the figures 91, for instance, might be turned into 19. It is a point, however, on which experiment alone could give a satisfactory decision.—[*Manchester Guardian.*

Lond. Mech. Magazine.

I am inclined to think that the easy compressibility of air, might prevent the impulses from reaching so great a distance as 25 or 50 miles.

G.

The Davy Lamp.

The following directions are given to miners in the use of their great protector, the lamp invented by Sir Humphrey Davy :—Whenever your gauze is coming to a *cherry-red heat*, be careful, and do not remain long, unless your business be *exceedingly* pressing; and, even then, your lamp must be changed, and that very often, and carefully. Caution is exceedingly requisite in moving it out to get cooled and exchanged. Have no oil on the gauze, nor have any defect in it. The above is an extreme case, in which the *greatest* care is needful. When you are traveling you should not allow the gauze to attain this heat; but should, on the approach to it, return into other air. You should often carefully examine your lamp, and then you will have timely notice of the approach of such dangerous circumstances. You will perceive first a high coloured spire on the flame; and that will be succeeded by a long one, even reaching to the top of the lamp, and then this will expand, or become larger, until your lamp soon becomes insufferably hot, and then speedily comes the cherry-red heat; then there is *great* danger. Observe, through all these transitions, even from the first appearance of the blue-coloured spire to the last, there is danger in exposing the naked flame. As soon as you see the long spiry pillar, it would be well often carefully to change the lamp. In a record of the various accidents in coal pits, on the Wear and Tyne, near Newcastle, since the year 1658 to 1838, amounting to 135 in number, only *one* out of 135 can be traced to the Davy, and that was by a boy letting it fall in changing it.—The gauze was damaged and then exploded the mine. Mining Review.

Oats changed to Rye.

In an article in Loudon's Magazine of Natural History, for November, 1837, various instances are given in which Oats that had been clipped for a few times in the warm season, so as to prevent them from forming stalks, and to enable them to live through the winter, had, during the second spring and summer, yielded a thin crop of Rye. The statement is not given by the author of the paper, or published by the editor, as a proof that Oats are changed into Rye, but as remarkable cases of a peculiar succession of vegetable species, under circumstances which render it very difficult to assign an adequate reason for the phenomenon. In one of the cases, the ground on which the oats were sown had been in grass for the last 15 or 20 years, and then planted with potatoes for 2 years, and then sown with oats and lucerne, which were used as sheep pasture so as to prevent the oats from stalking. The Oats were mostly killed by the severity of the cold in the spring, but when the lucerne was fit for pasture it was found intermixed

with a great many healthy rye plants just in flower. Perhaps some of our readers will repeat the experiments. The cases alluded to occurred on the continent of Europe. G.

Mr. Turner's Theorem.

Sir W. Hamilton at the late meeting of the British Association, made an exposition of Mr. Turner's theorem respecting the series of odd numbers, and the cubes and other powers of the natural numbers. Sir William stated, that if you take the series of odd numbers and divide them into groups, as below, of one, two, three, &c. terms, consecutively, the sums of these groups furnish the cubes of the natural numbers, as follows:

1	3 5	7 9 11	13 15 17 19
Sum=1	Sum=8=2^3	Sum=27=3^3	Sum=64=4^3.

And a theorem of a general kind could thus be stated: any power, n^m of any number n= sum of n consecutive odd numbers, the extremes being the sum and the difference of the next less power n^{m-1}, and the next less number $n-1$. For example, the 5th power of 3 is the sum of the three consecutive odd numbers, of which, the extremes are the next less power, namely, the fourth power of 3 or 81, and the next less number or 2, these extreme odd numbers being 79 and 83; the sum of all is $79+81+83=243=3^5$.

Professor Stevelly stated, that there was another curious property of the natural numbers, and their cubes, which he was not aware was generally known: it was this, that if you take a set of weights denominated by any number of the natural series of numbers and of their cubes, you can with these weights, by occasionally using some in one scale and some in the other, weigh up to the weight expressed by the sum of all used; thus:

1	2	3	4	5	&c.	natural numbers.
1	8	27	64	125	&c.	cubes.

Taking the weights denominated by 1, 2, 3; 1, 8, and 27, and you can with these six weigh any weight up to the sum of all, which is 42.

Lond. Mech. Magazine.

French Vineyard.

At the conclusion of an article of great learning and research, relative to the insects known to the Ancients and Moderns, by which the vine is infested, by Baron Walcknaer, (Scientific Memoirs, Part II,) the author concludes by the following statements: G.

In France, at the present day, 800,000 *hectares* [1,976,914 acres] of land are planted with the vine, the fruit of which, converted into wine, yields an annual produce of 760,000,000 francs, [£30,158,730 sterling.] The consideration, therefore, of the insects destructive of a plant which is the source of so much wealth, does not appear superfluous; and to lessen my regret at having so long occupied the time devoted by the Academy to researches of more importance, I would at least persuade myself that these minute inquiries are not devoid either of interest or utility.

Scientific Memoirs.

Belgian Railroads.

The line by which the Belgians propose to connect their western boun-

dary looking on the sea, with their eastern, bordering on Germany, is already so far completed, as to be opened from Termonde to Ghent. The ceremony took place on the 29th September: five locomotives drew a hundred carriages; music, fireworks, illuminations, and a banquet to king Leopold augmented the pleasures of the day. When the line is completed to Ostend, and a fast going packet placed on that station, the journey from London to Brussels may be effected in sixteen hours. Just double the time, or thirty two hours will be required for the passage from London to Paris, by a new route proposed by a French steam packet company, which intends to convey its passengers from London to Havre by a steamer, from Havre to St. Germain by the Seine, by a small boat, and from St. Germain to Paris by the new railway. Lond. Mech. Mag.

The Soil of France.

The soil of France is estimated to contain nearly 52,030,000 of hectares, which are distributed as follows:—

Arable	22,818,000
Woodland	6,522,000
Pasture	3,525,000
Meadow	3,488,000
Waste lands	3,841,000
Vineyards	1,977,000
Lands in special cultivation	780,000
Market gardens	528,000
Plantations of chesnut trees	406,000
Lakes	213,000
Sites of chateaux, country seats, out buildings	213,000
Marshes	186,000
Hop grounds	60,000
Ozier beds	53,000
Olive grounds	43,000
Parks and nurseries	39,000
Mines and quarries	21,000
Bogs and turf grounds	7,000
Mountains, roads, and rivers	6,555,000
Canals	9,000
Total	51,291,000

Farmers' Magazine.

Releasing Stoppers from Bottles.

Sir, as I have no doubt others of your readers, as well as myself, have frequently been inconvenienced by the stoppers of glass bottles becoming fixed, perhaps the following method of extracting them may prove useful to them. It was communicated to me by Mr. H. H. Clark, of Sheffield, with whom it originated, and has, I believe, never been made public. Having wiped the neck of the bottle perfectly dry, and seen that the little groove or channel between the stopper and the neck is quite clean, pour into the groove a few drops of *spirit of wine*, and having set it on fire, let it burn out, and then immediately give the stopper a few gentle taps with a light

wooden instrument, as the handle of a small spatula or chisel, and try to turn the stopper in an upward direction from *right to left.* I have, in most cases, found this effectual; but if it is not so the first time, it must be repeated.—*J. Fordred.* Lond. Mec. Mag.

Iron.

In little more than sixty years, the manufacture of this article in Britain has increased from about 25,000 to about one million of tons per annum, and in case the cost of production be reduced one half, it is impossible to estimate the future rate of increase; and surely the reduction in the consumption of coal from 7½ tons for one ton of iron, to less than 1½ tons, warrants the anticipation that it will be great. As, however, some of these modern improvements seem to open the way for the manufacture of iron in America, it behooves our legislature to allow the Americans to find a market at fair terms for the produce of their soil in this country, and then many generations may pass away before they can interfere with us in the iron manufacture. If railway once be extended through the west of Cumberland, the excellency, the abundance, and the proximity of the materials for the manufacture of iron, can hardly fail to plant some important branch of the iron manufacture on our coast.—*Whitehaven Herald.* Mining Journal.

Singular Circumstance.

We have often read of the imprisonment of Toads in rocks, and trees, but never heard of any one of these animals revealing its own hiding place in the way here mentioned. G.

During the Christmas, as Mr. Lukey, of Carminow, near Helston, sat amusing himself by the fire, one evening, his ears were suddenly assailed by cries resembling those of an infant, which apparently proceeded from the chimney, where lay a huge log of wood on fire, as it had been for three successive days, according to the universal custom of country folks at this season. The cries continued to increase, and on examining the log of wood he discovered a small hole incapable of admitting his finger. He split the wood, and, to his great astonishment, found a large toad entombed in the centre.—*West Briton.* Ibid.

Coals.

In the year 1780, the demand for coals amounted to 2¼ millions of tons per year; in the year 1838 to 18 millions. The increase of population (according to Bowring) has been during that period 90 per cent; the increase in the demand for coals 730 per cent, and it is calculated that there is no fear of a falling off in the supply for 2000 years.—*Raumer's England.* Ibid.

Comparative Anatomy.

A beautiful instance of the perfection of comparative anatomy, as applied to Ichthyology, was given by Sir P. Egerton to the Geological Section at Liverpool, on Friday the 14th. A scale found by him in one of the Yorkshire formations was sent to M. Agassiz, with a request that he would give his opinion as to the order in which the animal should be placed, and any detailed account of the probable shape and size of the fish he may think proper. This was done, and the whole organization of the fish regularly given. Sir Philip subsequently found a perfect specimen of the animal, which tallied exactly, *i. e.* as far as a fossil

would allow, with M. Agassiz's description. The announcement of this fact was received with great applause. ibid.

Birmingham Railway.

This company has no less than 3000 men employed on the extension only from Camden Town to Euston-square, that is about one mile and a quarter. The daily wages of these men amounts to £600, or at the rate of £180,000 per annum. We think this looks like earnest and business. The works are executed, we are informed, for we have not seen them, in a very masterly and substantial manner.—*Railway Magazine.* Ibid.

To preserve Wall Nails from Rusting.

I beg to communicate a little valuable information to those who use many nails for fastening wall trees. I use cast nails about one inch and a quarter long, and heat them pretty hot, in the fire shovel, over the fire, but not red, and then drop them into a glazed flower-pot saucer, half filled with train oil. They absorb a great deal of oil, and thus prepared never become rusty, and will last many years. The effluvia of the oil also, for a long time, I fancy, keeps insects from the trees.—*Magazine of Domestic Economy.* Farmer's Magazine.

Hydrogen Gas.

A scientific chemist, of great celebrity in France, has lately visited this country, for the purpose of taking out a patent for an economical process, by which he obtains from the decomposition of water, hydrogen gas, for the purpose of lighting houses and streets. His process has for some time been in very successful operation in France, but the method has been kept secret. He has now, however, undertaken to light the Royal Printing Office in Paris, with gas procured in the manner above-mentioned.—*Birmingham Gazette.* Mining Journal.

Machinery vs. *Steam.*

A practical experiment was made on Saturday, March 24, on the Railway, of a newly-invented machine, intended as a substitute for a locomotive steam-engine on railways, particularly on short or branch roads, where the expense of a locomotive steamer would be too costly for the traffic. The action is produced by a horse walking at an ordinary pace on a jointed platform, attached to the vehicle by a series of concealed machinery, which is so contrived that his weight and muscular strength are brought to act together, and to communicate a multiplying force to the larger or outside wheels of the machine, which are capable of being increased or diminished at the will of the conductor, so as to regulate the required speed. The trial was perfectly successful, notwithstanding the disadvantages of an untrained horse and new machinery. On the first application, the horse moved at a pace of four miles an hour, and subsequently conveyed the machine, which, with thirteen persons riding in it, weighed altogether four tons, at the rate of sixteen miles an hour. Lond. Journ. Arts & Sci.

LUNAR OCCULTATIONS FOR PHILADELPHIA, OCTOBER 1838.					Angles reckoned to the right or westward round the circle, as seen in an inverting telescope. ☞ For direct vision add 180° ☜	
Day.	H'r.	Min.	Star's name.	Mag.	from Moon's North point.	from Moon's Vertex.
9	10	19	N. App. ☽ & 47 Geminourn	6 ☽ N.0.'3		
10	17	0	Im λ Cancri	,6,	11	320
10	17	39	Em.		317	276
26	10	55	Im. φ Capricorni	6	110	152
26	11	53	Em.		311	359
30	10	16	Im. (189) Piscium	6	118	123
30	11	26	Em.		321	345

Meteorological Observations for April, 1838.

Moon.	Days	Therm. Sun rise.	Therm. 2 P.M.	Barometer. Sun rise.	Barometer. 2 P.M.	Wind. Direction.	Wind. Force.	Water fallen in rain.	State of the weather, and Remarks.
				Inch's	Inch's			Inches.	
	1	41	39	29.60	29.60	E.W.	Moderate.		Cloudy—do.
	2	32	49	55	55	W.	Brisk.		Clear—do.
	3	34	42	55	55	W.	Blustering		Lightly cloudy—do. do.
☾	4	33	59	63	65	W.	Calm.		Clear—flying clouds.
	5	37	59	85	95	W.	Moderate.		Clear—do.
	6	38	68	72	85	W.	Brisk.		Clear—do.
	7	38	52	80	94	E.	do.		Cloudy—do.
	8	40	44	90	80	E.	Moderate.	.50	Cloudy—rain
	9	44	57	55	55	W.	Brisk.	.01	Cloudy—shower,
	10	41	51	55	54	W.	do.		Partially cloudy—clear.
☉	11	42	58	54	54	W.	do.		Partially cloudy—do. do.
	12	33	52	90	98	W.	do.		Clear—flying clouds.
	13	36	54	30.05	30.05	W.	Moderate.		Clear—cloudy.
	14	40	43	29.94	29.96	NE.N.	do.	.04	Lightly cloudy—rain and snow.
	15	30	48	30. 3	90	SW.	do.	.08	Clear—cloudy—snow.
	16	30	41	29.95	30.10	NW.	do.		Clear—lightly cloudy.
	17	30	43	30.20	15	E.S.	do		Cloudy—do.
	18	44	65	29.75	29.60	SW.	Brisk.	1.46	Cloudy—rain with thunder.
☽	19	44	55	54	55	W.	do.		Cloudy—flying clouds.
	20	29	42	90	93	W.	do.		Clear—lightly cloudy.
	21	26	46	30.15	30.15	N.W.	do.		Clear—lightly do.
	22	38	68	29.65	29.65	SW.	do.		Cloudy—do.
	23	41	58	80	84	E.W.	Moderate.		Clear—cloudy.
	24	38	42	90	95	E.	do.	.40	Snow—hail—rain.
⊗	25	32	43	30.00	30.05	NE.	do.		Cloudy—do.
	26	37	52	29.85	29 70	E.	do.	.12	Cloudy—rain.
	27	48	62	60	70	W.	do.		Flying clouds—clear.
	28	53	75	75	65	NE.	do.	.26	Cloudy—thunder shower.
	29	52	72	55	55	NW.W.	Brisk.		Cloudy—flyi ng clouds.
	30	42	50	90	95	W.	do.		Clear—clear.
	Mean	38.10	52.96	29.79	29.7 9			2.87	

	Thermometer.	Barometer.
Maximum height during the month.	75.00 on 28th.	30.20 on 17th.
Minimum " " "	26.00 on 21st.	29.54 on 10th, 11th, 19th.
Mean	45.53	29.79

JOURNAL

OF THE

FRANKLIN INSTITUTE

OF THE

State of Pennsylvania,

AND

MECHANICS' REGISTER.

AUGUST, 1838.

Practical and Theoretical Mechanics and Chemistry.

Brief observations on Common Mortars, Hydraulic Mortars, and Concretes. By J. G. Totten, *Lt. Col. of Eng. and Brevet Col. United States Army.*

(Continued from p. 26.)

Article xxv.—*Some recent experiments with Mortars made of Lime and Sand.*

There will be presented, in conclusion, some experiments, made very recently at Fort Adams, with lime mortars without cement; they were instituted in reference to the best proportions of lime and sand, and also to a comparison of coarse and fine sand, and salt and fresh water.

In making these, a cask of fresh Smithfield lime, of the best quality, was taken, and the lumps broken into pieces of about the size of a pigeon's egg. These being carefully screened, in order to get rid of all dust and fine lime, and carefully intermixed, in order to obtain uniformity of quality throughout, were slaked by the affusion of water to the amount of one third the bulk of lime. When cold, the slaked lime was returned to the barrel, which was carefully headed and put in a dry place; and on all occasions of withdrawing a portion of this lime for use, the cask was carefully re-headed.

The sands used were those described in page 4, as sand No. 1, sand No. 2, sand No. 3, and sand No. 4.

In making the mortars, just enough water was added to the slaked lime taken from the cask, to make a stiff paste. This paste being passed through a hand paint mill, which ground it very fine, was mixed, by careful manipulation, with the due proportions of sand. Much care was bestowed upon the operation of filling the prism-moulds with mortar; and each prism was submitted to a pressure of 600 lbs. for a few minutes, that is to say while the succeeding prism was being formed.

About one week was consumed in preparing the prisms—namely, from

the 7th to the 15th of May, 1838. And they were broken on the 1st of July, 1838, making the average duration of the experiment, 50 days.

Three prisms were made of each composition. But, on the principle that there are several causes which tend to make a prism weaker than it should be, and few or none that tend to make it stronger, only the maximum result of each experiment is given in the following table.

It may, however, be well to state that precisely the same inferences are deduceable, if the mean of the results be taken instead of the maximum.

Table No. LXX.

Trials made on the 1st of July, 1838 of the strength of the mortars made between the 7th to 15th of May, 1838 (50 days.) The results show the weights, in pounds, required to break prisms of mortar 6 inches long, by 2 inches by 2 inches: the distance between the supports being 4 inches, and the power acting midway between the supports.

Composition of the mortars.	Sand No. 1.—Lime. Fresh water.	Sand No. 2.—Lime. Fresh water.	Sand No. 3.—Lime. Fresh water.	Sand No. 4.—Lime. Fresh water.	Sand No. 1.—Lime. Salt water.	Sand No. 3.—Lime. Salt water.
Lime in stiff paste 1—Sand 0	262½					
do. 1 do. ¼	224	220½	248½	353½	192½	234½
do. 1 do. ½	213½	234½	234¼	241½	210	199½
do. 1 do. 1	248½	220½	227½	234½	178½	178½
do. 1 do. 2	164½	199½	161	178½	140	178½
do. 1 do. 3	157½	189	185½	157½	119	119
do. 1 do. 4	126	227½?	157½	136½	101½	154

Observations on the experiments of table No. LXX.

1st. Within the limits of the experiments, the mortar was the stronger as the quantity of sand was the less—in 96 comparisons, 12 exceptions.

2nd. Although the above inference is derived from the whole range of the table, still, when the quantity of sand was less than the quantity of lime, the weakening effect of the sand on the mortar was not very sensible. And it would seem from table No. LXV. that from one-fourth to one-half of sand may be slightly beneficial.

3rd. It appears that coarse sand, or, rather, sand composed of coarse and fine particles, (sands No. 1 and 2,) is a little inferior to sand that is all fine (sands No. 3 and 4;) in 36 comparisons, 16 exceptions; and also that sand reduced by pounding to a fine powder (No. 4,) afforded some of the best results of the table. It is to be regretted that no experiments were instituted in order to compare sand all coarse, with sand all fine.

4th. It appears that the mortars made with salt water—that is to say, the water of the ocean, was decidedly weaker than those made with fresh water; 1 exception in 12 comparisons. The aggregate strength of all the

prisms made of coarse sand and salt water was 2674 lbs.; while the aggregate strength of the corresponding prisms of coarse sand and fresh water was 3174 lbs. And the aggregate strength of all the prisms of fine sand and salt water was 2800lbs. while the aggregate strength of the corresponding prism of fine sand and fresh water was 3346 lbs.

Description of the Plates.

PLATE I.

Fig. 1. *a*, *a*, Prism of mortar under trial.
b, *b*, Iron stirrups, supporting the prism.
c, *c*, Iron collar, embracing the prism.
d, *d*, Iron link, to which the ropes of the scale-pan are fastened.
e, *e*, check, against which the collar rests when on the middle of the prism.
f, *f*, Timber, to which the stirrups are attached.
g, Scale pan, in which the weights to break the prism are put.
Fig. 2. *h*, Interior of the furnace.
i, Door of the furnace.
k, *k*, Chimney.
l, Register.
m, *m*, Arches, under the hearth, in which the fuel is placed.
n, *n*, Conduits, to lead the flame and a current of air into the furnace.
Fig. 3. *o*, Plan of lime kiln.
p, *p*, Nut of the kiln.
q, *q*, Steps descending to the doors of the kiln.
r, Steps, up which the materials are carried to the top of the kiln.
s, *s*, Doors of the kiln.
t, *t*, Portions of spherical arches leading to the doors of the kiln.

PLATE II.

Figs. 4, 5, 6, 7 and 8, represent Mr. Petot's "*curves of energy*" of fat lime, hydraulic lime—plaster-cements—calcareous puzzolanas, and clay.
Fig. 9. *a*, *b*, Half staples, driven into the floor.
f, *g*, A pair of bricks united by mortar.
c, *c*, Iron piece, embracing the ends of the upper brick, and suspended from the steelyard.
d, Steelyard.
e, Bucket, into which sand flowed from the trough.
h, Trough.
i, Floor.
Fig. 10. *a*, *b*, *c*, Iron lever, with a steel point at *a* to impress the mortar *f*, on the brick *g*.
d, Steelyard, connected with the lever *a*, *b*, *c*, at *c*.
e, Iron rod, from which the steelyard is suspended.
h, *h*, Uprights, supporting the rod *e*.
i, Uprights of iron, supporting the fulcrum of the lever *a*, *b*, *c*.

Physical Science.

FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

Note on the Solar Eclipse of May 15*th*, 1836, *by* SEARS C. WALKER.

In the Journal of the Franklin Institute, vol. xvii, p. 246, 1836, I have given the formulæ for the ready announcement of the phases of this eclipse, and in vol. xviii, p. 97, a modification of the same for determining the longitude from Greenwich, of places of observation near Philadelphia. The arrival of the European observations and computations relative to this eclipse, has furnished the means of reducing the observations made in this country, and of determining longitudes with an accuracy nearly equal to that of the observations themselves. There are two principal methods by which such computations are made. The first, which is the one generally employed in this century, consists in deducing from the observation the local time of new moon; then the difference of the local times of the same event are taken for the difference of longitude of the places of observation. But since the errors of the tables affect these local times of new moon differently at different places, allowance must be made therefor to obtain the true differences of longitude.

The European observations of this eclipse have been reduced in this manner by a distinguished astronomer, C. Rümcker, of Hamburg. His computations have furnished him the following approximate corrections of the elements of the eclipse as given in the Berlin Jahrbuch.

$$
\begin{aligned}
(1)\cdots\quad \Delta\beta &= -7.''63 = \text{cor. moon's tab. latitude.}\\
\Delta(\odot + \text{☽}) &= -1.''00 = \text{cor. tab. sum of semidiameters.}\\
\Delta(\odot - \text{☽}) &= -2.''00 = \text{cor. tab. difference.}\\
\Delta\pi &= 0.''00 = \text{cor. moon's tab. parallax.}
\end{aligned}
$$

These corrections he has left subject to a more full discussion when a greater number of observations is obtained. Rümcker's computations are published in Schumacher's Astronomical Notices, No. 319. A translation of them may be found in the London & Edinburgh Philosophical Magazine, vol. x, p. 180, 1837, with the formulæ by which they are made. These formulæ are given more at length in this author's interesting paper on the solar eclipse of the 3—4 March 1840, (received through the politeness of Prof. A. D. Bache) which is one of the best models yet published of this method of reducing the observations of a solar eclipse.

The second method consists in making the unknown quantity the longitude sought, and in deducing from the observations, an approximate value for this longitude to be afterwards corrected for the effect of the errors of the tables, which, as in the other method is different at different places. This method founded on the fundamental equation of eclipses originally published by Lagrange in the Berlin Jahrbuch, for 1782, was first given to the world by Bessel in the Astronomical Notices, No. 151 and 152, and received from its author, the finishing hand in 1836 in a paper No. 321, on the then recent eclipse of May 15th. In reading these papers we are astonished at the genius of the analyst who has succeeded in giving a new and more perfect form to the method of reducing this kind of observations, as he has by his former works to most of the computations in practical astronomy. Mr. Bessel here reduces the principal corrections of the tabular errors to the three following, viz: of the moon's tabular place on the orbit—

—on a perpendicular to the orbit—and of the sum or difference, of the sun's and moon's assumed semidiameters; which he denotes severally by ι, ζ, and η or η'. He also points out an error to which many of the reductions of eclipses and occultations by the old method have been liable where the longitude is not well ascertained—and which, where the duration is short, may wholly vitiate the result. This source of error consists in the assumption of the constancy of the moon's latitude or declination during a time equal to the required correction of the assumed longitude.

A complete discussion of the European observations after Bessel's method, is given by H. C. F. Peters, in No. 326, of the Astronomical Notices. From them he deduces the following corrections of the elements derived from the Berlin Jahrbuch.

$$(2)\cdots\quad \iota = -3.''650 - 0.0082\eta' + 0.0007\eta$$
$$\zeta = -5.''472 - 0.1590\eta'$$

Where

$$\eta = \triangle(\odot + \text{☽}) \text{ of Rümcker nearly.}$$
$$\eta' = \triangle(\odot - \text{☽}) \quad \text{"} \quad \text{"} \quad \text{"}$$

This value of ζ is derived from the observed duration of the ring at Braunsburg, Pillau, Rostock, Stralsund and Copenhagen (Round Tower.) That of ι is derived from the observations of the beginning and end at Altona, Berlin, and Königsberg. The coefficients of η and η' are so small that no sensible error can arise from neglecting them. To change ι and ζ into right ascension and declination, recourse may be had to Bessel's formulæ. Astr. Nachr. vol. x, p. 138.

$$(3)\cdots\quad \iota = \sin. N. \cos. \delta \triangle \alpha. + \cos. N. \triangle \delta$$
$$\zeta = -\cos. N. \cos. \delta \triangle \alpha. + \sin. N. \triangle \delta - x \cos. \pi \triangle \pi$$

Whence

$${}^*(4)\cdots\quad \triangle \alpha = [\iota \sin. N. - \zeta \cos. N. - x \cos. N. \cos. \pi \triangle \pi] \sec. \delta$$
$$\triangle \delta = \iota \cos. N. + \zeta \sin. N. + x \sin. N. \cos. \pi \triangle \pi$$

The moon's nearest approach to the sun in her true orbit, takes place at 3h mean time Berlin, nearly. For this time I find from Peters' co-ordinates and the elements in the Berlin Jahrbuch.

$$(5)\cdots\quad x = 0.47147 = L. \sin. 1.'' \operatorname{cosec}. \pi$$

L = least distance of centres in true orbit in seconds of arc.
$N = 70^\circ\ 11'\ 10.''4$ = moon's orbital angle.
$\delta = 19^\circ\ 22'\ 40.''3$ = moon's true declination.
$\alpha = 52^\circ\ 13'\ 48.''2$ = moon's true R. ascension.
$\pi = 54'\ 24.''1$ = moon's horizontal equatorial parallax.

The equations (2) and (4,) with the values in (5) give,

$$(6)\cdots\quad \triangle \alpha = -1.''6794 - 0.1693 \times \triangle \pi$$
$$\triangle \delta = -6.''3844 + 0.4436 \times \triangle \pi$$

Calling the corrections of the moon's tabular longitude $\triangle\lambda$, Airy's formulæ, Greenwich observations for 1836, for changing $\triangle \alpha$ and $\triangle \delta$ into $\triangle \lambda$ and $\triangle \beta$, are,

*Bessel ibid. p. 140, omits the terms containing $\triangle \pi$ I have found it necessary to retain them in comparing together the results by the two methods.

$$(7)\cdots \qquad \Delta\lambda = \frac{P}{15}.\Delta\alpha + Q\Delta\delta$$
$$\Delta\beta = \frac{R}{15}.\Delta\alpha + S\Delta\delta$$

Also in his tables of these coefficients we find from the arguments α and δ in (5.)

$$(8)\cdots \qquad \frac{P}{15} = +0.9147$$
$$Q = -0.2440$$
$$\frac{R}{15} = +0.2313$$
$$S = +0.9690$$

and from (6,) (7) and (8,)

$$(9)\cdots \qquad \Delta\lambda = +0.''0214 - 2.6311 \times \Delta\pi$$
$$\Delta\beta = -6.''5740 + 0.3906 \times \Delta\pi$$

The mean of Rümcker's equations of condition from the observed beginning and end, at Altona, Hamburg, Copenhagen, Bremen, and Berlin, give,

$$(10)\cdots \qquad \Delta\lambda = -2.''074 - 0.0630 \times \Delta'\beta + 0.0005 \times \Delta'(\odot + \rightmoon) - 0.5849 \times \Delta'\pi$$
$$\Delta\beta = -7.''630 + \Delta'\beta$$
$$\Delta(\odot + \rightmoon) = -1.'' \quad + \Delta'(\odot + \rightmoon)$$
$$\Delta\pi = \quad 0 \quad + \Delta'\pi$$

Where an accent over the Δ denotes a further correction of Rümcker's approximate values in (1.) The values of the corrections derived from the two computers in (9) and (10,) will coincide when we make,

$$(11)\cdots \qquad \Delta'\beta = +1.474$$
$$\Delta'(\odot + \rightmoon) = -0.''112$$
$$\Delta'\pi = +1.''069$$

Whence

$$(12)\cdots \qquad \Delta\lambda = -2.''791$$
$$\Delta\beta = -6.''156$$
$$\Delta(\odot + \rightmoon) = -1.''112$$
$$\Delta\pi = +1.''069$$

The coincidence, of the results of these independent computations by methods wholly different, removes all probability of error in either. Bessel's method, however, appears more simple, inasmuch as the corrections of the place of the moon are reduced to two unknown quantities ϵ and ζ which are derived with greater facility and accuracy from the equations of condition, than the three unknown quantities $\Delta\lambda$, $\Delta\beta$, $\Delta\pi$, referred to in the old method. Accordingly I have adopted Bessel's method and Peters' corrections in reducing the American observations.

The importance of this eclipse for perfecting our geography, from the number and accuracy of its observations at home and abroad, is such that I have thought it useful to append a table of the final results from all the observations. Those from the European are taken from Peters' paper. Those from the American, were computed by myself first from Bessel's formulæ, Astr. Nachr. No. 152, and afterwards re-computed from Peters' co-

ordinates for the end, and mine for mean noon Berlin for the beginning. The second computations, however, gave no other change in the final results than that which arises from a change in the sun's mean semidiameter, which in Bessel's paper, No. 319, is derived from his reduction of the observations of the transit of mercury over the sun's disc in 1832, and is 1.″112 smaller than that which is derived from transit observations of the sun's limbs, which are believed to be affected by the irradiation of the telescope.

In the table below, m is the resulting longitude + east — west from Greenwich, affected by the errors of the elements in the Berlin Jahrbuch, the sun's semi-diameter being diminished 1.″112; a, b, and c, are the coefficients of the three principal corrections ε, ζ, and η or η'; so that d being the longitude corrected for these errors we have,

$$d = m + a\,\varepsilon + b\,\zeta + c\,\eta$$

It is found impossible to assign any value of η or η', which will satisfy all the observations, or even those made at the same place by different observers; indeed this value depends upon the size of the telescope, the power used, and the nice adjustment of the focal distance for the eye of the observer. Omitting this correction and making,

$$d' = m + a\,\varepsilon + b\,\zeta = m - 3.''650 \times a - 5.''472 \times b$$

we have the value of d' in the table below, which is the most probable longitude of the places of observation from Greenwich that can be deduced from this eclipse. I will here take occasion to remark that x in my former paper in vol. xviii. page 9, 1836, is equivalent to $a\,\varepsilon + \frac{1}{2}(b_, + b')\,\zeta$ or to the half sum of corrections for the errors of the tables, for the beginning and end of the eclipse. The mean of the Philadelphia observations gave from an assumed longitude of 5h. 0m. 40s., a result which compares with Peters' correction as follows,

$x = -$ 11.04s. by my computations.
$x = -$ 10.60s. by Peters' "

a co-incidence which confirms the accuracy of the assumed longitude of the State House; indeed the mean of all the Philadelphia observations compared with the European, gives,

Longitude of State House = 5h. 0m. 39.6s.

To this result great weight should be attached; for we have five good observations of beginning and end here, and an ample number in Europe. I deem it proper in this place to add that the error of the three chronometers used at the Philosophical Hall, 100 South 8th street, and at T. M'Euen's house, were determined from comparison together immediately after the eclipse, and from my transit observations of the sun, and of stars in the evening following, checked by Eastern and Western altitudes of the sun, by two observers, Mr. Riggs and myself, with different sextants; the transit observations were corrected for instrumental deviations; so that the chronometers were not liable to an error of more than 0.4s. Mr. Sellers' observations were made with his own clock by Lukens, which has few superiors in any country, and its error was determined by Mr. Sellers' transit instrument by Young, and agreed with that furnished by my observations, after allowing for the difference of meridians.

The table of reduced observations, is here subjoined, the last column d' is the longitude from Greenwich, derived from the observation.

Place of observation.	Mean time of observation.	*m*	*a*	*b*	*c*	*d'*
	h m s					m s
Altona, *Schumacher*	2 43 50.8B	+39 53.18	+2.158	—0.112	+2.161	+39 45.92
cher and *Son.*	5 21 23.2E	+39 54.40	+2.159	—0.055	—2.160	+39 46.82
Apenrade,	2 40 38.4B	+38 17.43	+2.158	—0.021	+2.158	+38 9.67
Hansen & *Fischer.*	4 0 5.6BR	+37 57.78	+2.159	—0.063	+2.159	+38 50.25
	4 4 23.1ER	+37 50.87	+2.159	—0.094	—2.161	+37 43.50
Berlin,	3 2 43.8B	+53 41.91	+2.158	—0.181	+2.165	+53 35.03
Encke.	5 37 31.9E	+53 46.18	+2.160	—0.040	—2.160	+53 38.52
Bern,	2 37 8.6B	+30.16.64	+2.158	—0.529	+2.222	+30 11.66
Treschel.	5 16 48.2E	+29 49.47	+2.160	+0.342	—2.187	+29 39.72
Braunsburg,	3 33 40.2B	+79 43.02	+2.158	—0.061	+2.159	+79 35.48
Feldt and *Becker.*	4 49 23.6BR	+79 35.65	+2.159	+1.277	+2.508	+79 20.79
	4 52 34.2ER	+79 14.64	+2.159	—1.647	—2.715	+79 15.78
	6 1 40.1E	+79 20.91	+2.159	—0.214	—2.170	+79 14.19
Bremen,	2 38 12.0B	+35 18.41	+2.158	—0.102	+2.160	+35 11.09
Cluver and *Wolf.*	5 16 56.9E	+35 17.37	+2.159	—0.018	—2.160	+35 9.58
Bremerhafen,	2 37 27.0B	+35 0.63	+2.158	—0.109	+2.160	+34 53.35
Thulesius.	5 15 27.0E	+34 30.51	+2.159	—0.033	+2.160	+34 22.81
Brussels,	2 16 0.5B	+17 36.32	+2.158	—0.255	—2.173	+17 29.84
Quetelet.	4 59 47.3E	+17 37.49	+2.159	+0.152	+2.165	+17 28.78
Copenhagen, (Hol-	2 55 52.8B	+50 31.21	+2.158	+0.010	+2.158	+50 23.28
ken's, Bastion,)	4 15 53.2BR	+51 2.76	+2.159	+3.580	+4.180	+50 35.29
Pedersen.	5 29 32.9E	+50 11.19	+2.159	—0.193	—2.168	+50 4.36
Copenhagen,	2 56 3.7B	+50 39.89	+2.158	+0.011	+2.158	+50 31.96
(Round Tower)	4 15 37.1BR	+50 49.02	+2.159	+3.618	+4.213	+50 21.35
Olufsen.	5 29 32.9E	+50 11.88	+2.159	—0.193	—2.168	+50 5.05
(*)	5 33 43.0E	+48 9.96	+2.160	+0.062	—2.160	+48 1.74
(†)	4 39 12.3E	+ 10.59	+2.159	+0.158	—2.165	+ 1.84
Halifax,	1 39 8.0B	— 8 12.97	+2.158	—0.027	+2.158	— 8 20.69
Waterhouse.	4 27 7.0E	— 8 14.57	+2.159	+0.043	—2.160	— 8 22.68
Hamburg, *Rüm-*	2 44 6.3B	+40 5.25	+2.158	—0.112	+2.161	+39 57.99
cker and *Peters.*	5 21 30.5E	+40 1.45	+2.160	—0.055	—2.160	+39 53.86
Hanover,	2 43 49.0B	+39 7.64	+2.158	—0.183	+2.165	+39 0.77
Lahmayer.	5 21 48.7E	+38 59.05	+2.159	+0.010	—1.159	+38 51.12
Jena, *Schrön.*	5 31 35.0E	+46 31.29	+2.160	+0.065	—2.161	+46 23.04
(‡)	3 36 19.2B	+82 8.81	+2.158	—0.040	+2.158	+82 1.16
	6 3 58.7E	+82 4.14	+2.159	—0.239	—2.173	+81 57.57
London,	1 51 13.0B	+ 0.04	+2.158	—0.182	+2.165	+ 6.84
Simms, jr.	4 38 47.0E	— 10.21	+2.159	+0.152	—2.165	+ 18.95
Louvain,	2 17 37.3B	+19 18.65	+2.158	—0.249	+2.172	+19 12.16
Crahay.	5 0 52.6E	+18 37.29	+2.159	+0.147	—2.164	+18 28.61
Makerstown,	1 36 51.2B	— 9 39.71	+2.158	+0.081	+2.159	— 9 48.02
Brisbane.	3 1 4.2BR	— 9 35.22	+2.158	+0.143	+2.163	— 9 43.88
	3 5 11.6ER	— 9 55.48	+2.158	—0.129	—2.162	—10 2.69
	4 23 0.6E	— 9 54.45	+2.159	—0.056	—2.160	—10 2.02
Neumühlen,	2 43 54.4B	+39 55.86	+2.158	—0.112	+2.161	+39 48.60
Zahrtman.	5 21 20.6E	+39 51.86	+2.159	—0.055	—2.160	+39 44.28
Neustrelitz,	3 0 23.0B	+52 32.86	+2.158	—0.130	+2.162	+52 25.70
Lorentz & *Becker.*	5 34 58.0E	+52 19.40	+2.160	—0.079	—2.161	+52 11.95

*Gera, *Metz* and *Engelhardt.*
†Greenwich, *Airy* and four others.
‡Königsberg, *Bessel, Son* and *Busch.*

Place of observation.	Mean time of observation.	m	a	b	c	d′
	h m s	h m s				
Pillau,	4 49 56.5BR	+ 79 57.09	+2.159	+2.533	+3.328	+ 79 35.35
Schwink.	4 51 57.6ER	+ 79 24.73	+2.159	—3.117	—3.791	+ 79 33.91
Rostock,	2 54 43.1R	+ 48 36.43	+2.158	—0.083	+2.159	+ 48 29.01
Karsten.	2 14 19.7BR	+ 48 36.18	+2.159	—1.965	+2.919	+ 48 39.05
	4 17 58.2ER	+ 48 48.46	+2.159	+1.596	—2.684	+ 48 31.85
	5 29 58.2E	+ 48 33.24	+2.159	—0.107	—2.162	+ 48 25.95
(*)	1 51 52.1B	+ 27.40	+2.158	—0.185	2.165	+ 20.54
	4 39 20.1E	+ 16.66	+2.159	+0.158	—2.165	+ 7.92
Steltin,	3 7 51.7B	+ 58 22.61	+2.158	—0.126	+2.161	+ 58 15.43
Dancke.	5 41 16.3E	+ 58 23.51	+2.160	—0.101	—2.162	+ 58 16.18
Stralsund,	2 59 44.2B	+ 52 40.02	+2.158	—0.071	+2.159	+ 52 32.54
Sieinort.	4 18 7.0BR	+ 52 24.17	+2.159	—0.865	+2.325	+ 52 21.03
	4 22 26.6ER	+ 52 33.00	+2.159	+0.613	—2.244	+ 52 21.77
	5 33 49.2E	+ 52 27.62	+2.159	—0.103	—2.163	+ 52 20.30
Strasburg,	2 36 45.1B	+ 31 15.48	+2.158	—0.419	+2.198	+ 31 9.90
Herrenscheider.	5 16 44.9E	+ 30 53.41	+2.160	+0.243	—2.173	+ 31 44.20
Tondern,	2 37 15.0B	+ 35 37.44	+2.158	—0.026	+2.158	+ 35 29.71
Petersen.	3 57 26.7BR	+ 35 37.16	+2.159	—0.337	+2.193	+ 35 31.38
	4 1 48.1ER	+ 35 35.29	+2.159	+0.229	—2.171	+ 35 26.16
	5 14 51.0E	+ 35 32.60	+2.159	—0.117	—2.163	+ 35 25.36
(†)	5 54 37.1E	+ 65 36.52	+2.160	+0.148	—2.165	+ 65 27.82
(‡)	2 47 4.0B	+ 39 52.34	+2.158	—0.337	+2.184	+ 39 46.30
	5 32 40.0E	+ 47 40.87	+2.160	+0.053	—2.160	+ 47 32.69
Washington, (Cap-	18 53 58.0B	—5 7 53.26	+2.157	+1.242	+2.489	—5 8 7.92
itol,) *Hassler.*	21 20 8.0E	—5 8 12.46	+2.158	—0.252	—2.172	—5 8 18.98
Haverford Pa.,	19 3 24.5B	—5 0 51.82	+2.157	+1.232	+2.484	—5 1 6.43
I. Gummere.	21 31 47.0E	—5 1 17.12	+2.158	—0.249	—2.171	—5 1 23.67
Germantown,	19 3 55.5B	—5 0 23.65	+2.157	+1.229	+2.482	—5 0 38.25
C. Wistar.	21 32 49.5E	—5 0 34.66	+2.158	—0.232	—2.170	41.26
Germantown,	19 3 54.5B	—5 0 24.77	+2.157	+1.229	+2.482	39.37
I. Lukens.	21 32 44.5E	—5 0 38.18	+2.158	—0.232	—2.170	44.78
§State House,	19 3 38.0	—5 0 25.41	+2.157	+1.227	+2.481	—5 0 39.99
Phila. *T. M'Euen.*	21 32 38.1	33.20	+2.158	—0.252	—2.171	39.82
State House,	19 3 50.0	13.14	+2.157	+1.226	+2.481	27.72
W. H. C. Riggs.	21 32 26.5	41.43	+2.158	—0.232	—2.170	48.04
State House,	19 3 40.9	24.66	+2.157	+1.225	+2.481	39.24
S. C. Walker.	21 32 44.1	30.86	+2.158	—0.228	—2.170	37.48
State House,	19 3 45.8	20.42	+2.157	+1.225	+2.481	34.90
R. M. Patterson.	21 32 38.3	35.93	+2.158	—0.229	—2.170	42.57
State House,	19 3 41.0	25.00	+2.157	+1.225	+2.481	39.47
S. Sellers.	21 32 34.0	39.46	+2.158	—0.229	—2.170	46.80
(¶)	19 12 48.5	—4 53 12.11	+2.157	+1.203	+2.451	—4 53 26.66
	21 43 40.0	—4 53 50.70	+2.158	—0.206	—2.170	—4 53 57.45
Southwick, Mass.	19 17 52.2	—4 50 51.94	+2.157	+1.226	+2.463	—4 51 6.53
Holcomb.	21 49 20.1	—4 51 13.36	+2.158	—0.231	—2.170	—4 51 19.97

*Shooter's Hill, *Hodgson, Simms, jr., Simms, sen.* and *Gilby.*

†Vienna, *Hallascha, J. J. Littrow, C. J. Littrow, Böhn, Brestel.*

‡Wurtzburg, *Schoen, J. Zeitz.*

‖The observation at Pillau is affected with the clock's error.

§The values of *m* and *d′* for the Philadelphia observations are reduced to the State House.

¶ West Hills, (Coast Survey,) *Ferguson.*

§A highly interesting memoir on a remarkable phenomenon which occurs in total and annular eclipses, by Francis Bailey, Esq., Vice President of the Royal Astronomical Society, has been published in the 10th volume of the memoirs of that society. I have appended an extract from this memoir, describing this phenomenon as observed by Mr. Bailey, at Inch Bonney, Lat. 55° 27′ 30″, Long. 10m 12s.0 west of Greenwich, situated in the path of the centre of the annular eclipse of May, 1836. For the early receipt of a copy of this memoir from the author, I am indebted to the attentions of Prof. Alex. Dallas Bache. It is hoped that the annular eclipse of Sept. 18th, 1838, will, if the weather permits be observed with reference to the phenomenon described by Mr. Baily. The city of Washington, near its central path, will afford an excellent position for observation. The computations of R. T. Paine Esq., in the American Almanac, or the formulæ for the announcement of its principal phases with the geographical limits of the annular phase, in E. O. Kendall's paper published in the Journal of the Franklin Institute vol. xx p. 125, will serve as a guide to observers in the choice of a favourable position. The last annular eclipse of the sun observed at this place was by Rittenhouse, April 3rd, 1791. From inspection of Mr. Paine's list of eclipses for the rest of the century, in the American Almanac for 1831, pages 70 to 76, it does not appear that any other annular eclipse will occur at this place in the 19th century.

I. *On a remarkable Phenomenon that occurs in Total and Annular Eclipses of the Sun. By* Francis Bailey, Esq., *Vice-President of this Society, &c. &c.*

The following are the observations as shewn by one of the chronometers, adjusted, from a mean of all the comparisons, to the correct mean time at Inch Bonney.

Beginning of the eclipse	1h	36m	44s	
Formation of the annulus	3	0	57	subject to discussion.
Dissolution of the annulus	3	5	23	See page 159.
End of the eclipse	4	23	7	

The diminution of light was not so great, during the existence of the annulus, as was generally expected; being little more than might be caused by a temporary cloud passing over the sun: the light however was of a peculiar kind, somewhat resembling that produced by the sun shining through a morning mist. The thermometer in the shade fell only about three or four degrees: it was 61° during the time of the annulus. About twenty minutes before the formation of the annulus, *Venus* was seen with the naked eye: and a few minutes afterwards I found it impossible to fire gunpowder with the concentrated rays of the sun through a lens of three inches in diameter. The same lens likewise had no effect on the bulb of a thermometer, during the existence of the annulus. Similar results also were obtained by Sir Thomas Brisbane.

As preceding writers have noticed the tendency of the birds of the field and of the poultry, to go to roost during the darkness occasioned by a great eclipse, I would here remark that nothing of the kind occurred on this occasion in the district where I was placed.* On the contrary the birds in the hedges were in full song during the whole time of the eclipse: and I noticed to Mr. Veitch that one cock in particular, in a neighbouring farm-yard

*This supposed *darkness* has always been overrated, even in total eclipses. The light which remains, after the sun is wholly covered, is sometimes as great as that of the *full moon.*

was crowing with all his might, whilst we were observing the remarkable phenomenon of the annulus.

Having made these general remarks I shall now proceed to detail those singular appearances which occurred at the formation and dissolution of the annulus; and which have never yet, as far as I have been able to ascertain, been described in a complete and connected manner, in any preceding accounts. For, although detached portions of the phenomenon have been recorded by different observers, as seen at different places, yet it is impossible, from those descriptions, to form an accurate idea of the *whole*, or to trace the origin, progress, and termination of that remakable phenomenon which immediately precedes the complete formation of the annulus, and which again takes place (but in an inverse order) immediately after the commencement of the dissolution of the annulus. In fact, since the phenomenon itself, during its short period of existence, constantly varying in some minute particulars, no description of any one detached portion of it will enable us to judge of the remainder: and thus the partial accounts of different observers (alluding probably to different stages of the phenomenon) become confused and perplexing.

The weather at Inch Bonney was remarkably favourable for observation: the sky was perfectly clear and serene; not a cloud to be seen in any part of the heavens, during the whole time of the eclipse. When the last portion of the moon's disc was about to enter on the face of the sun, I prepared myself to observe the formation of the annulus. I was in expectation of meeting with something extraordinary; but imagined that it would be momentary only, and consequently that it would not interrupt the noting of the time of its occurrence. In this, however, I was deceived, as the following facts will shew. For when the cusps of the sun were about 40° asunder, a row of lucid points, like a string of bright beads irregular in size and distance from each other, *suddenly* formed round that part of the circumference of the moon that was about to enter, or which might be considered as having just entered, on the sun's disc. Its formation indeed was so rapid that it presented the appearance of having been caused by the ignition of a fine train of gunpowder. This I intended to note as the correct time of the formation of the annulus, expecting every moment to see the thread of light completed round the moon; and attributing this serrated appearance of the moon's limb (as others had done before me) to the lunar mountains, although the remaining portion of the moon's circumference was comparatively smooth and circular, as seen through the telescope. (See fig. 1.) My surprise however was great on finding that these luminous points, as well as the dark intervening spaces, increased in magnitude, some of the contiguous ones appearing to run into each other like drops of water: for, the rapidity of the change was so great, and the singularity of the appearance so fascinating and attractive, that the mind was for the moment distracted, and lost in the contemplation of the scene, so as to be unable to attend to every minute occurrence. Finally, as the moon pursued her course, these dark intervening spaces (which, at their origin, had the appearance of lunar mountains in high relief, and which still continued attached to the sun's border) were stretched out into long, black, thick, parallel lines, joining the limbs of the sun and moon; when, all at once, they *suddenly* gave way, and left the circumferences of the sun and moon in those points, as in the rest, comparatively smooth and circular; and the moon perceptibly advanced on the face of the sun. This moment, therefore, may, by some persons, be considered as the complete formation of the annulus, and has, I believe, in

most cases, been recorded as such: but I shall state my reasons presently why I think this should not be assumed as the true moment of the astronomical phenomenon.

Fig. 1

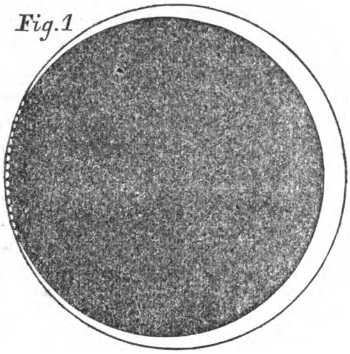


Fig. 2

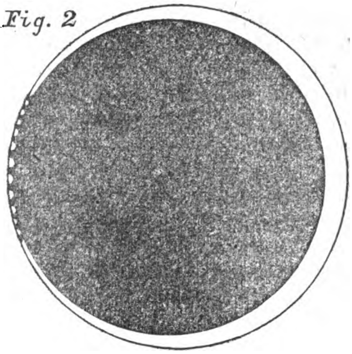


Fig. 3

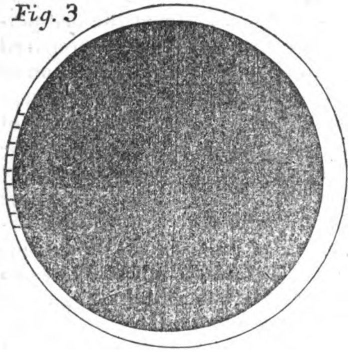
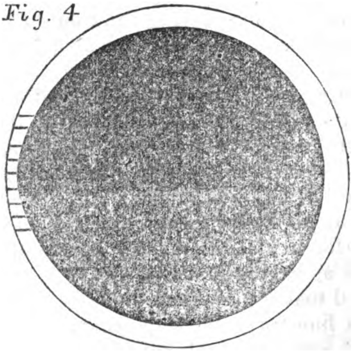


Fig. 4



The appearances here recorded passed off in less time than it has taken me now to describe them; but they were so extraordinary and so rapid, that all idea of time was lost, except by the recollection afterwards of what had passed: for, I was so riveted to the scene, that I could not take my eye away from the telescope, to note down any thing, during the *progress* of this phenomenon. I estimate, however, that the whole took up about six or eight seconds, or perhaps ten at the utmost. In the plate annexed to this memoir, I have endeavoured to delineate the several phases above mentioned, in three of its most striking stages. Fig. 1 represents the first appearance of the luminous string of beads just formed round the edge of the moon; which was almost instantaneous. Fig. 2 represents a *continuation* of the same phenomenon, or the moon further advanced on the face of the sun, but still apparently adhering to its border by means of the dark, thick, irregular spaces which separate the luminous portions, now become somewhat enlarged in size. Fig. 3 represents still a *continuation* of the same phenomenon; the dark parts being now stretched out into long, black, lines which seemed to connect together the limbs of the sun and moon; and are here represented as they appeared immediately before their sudden rupture, and total disappearance. In all these representations on the plate, the moon is supposed to be proceeding in a horizontal direction, from the


Barometer
STORM ON THE 18th
BAR.
Calm
Cloudy
Snow
Rain
Hail
Missouri River
MISSOURI
Storm

left hand towards the right. I cannot describe these phenomena (or rather this phenomenon, for it was one *continuous* appearance) more correctly than by supposing, for the moment, that the edge of the moon was formed of some dark glutinous substance, which by its tenacity adhered to certain points of the sun's limb, and by the motion of the moon was thus drawn out into long threads, which suddenly broke and wholly disappeared.

After the formation of the annulus thus described, the moon preserved its usual circular outline during its progress across the sun's disc, till its opposite limb again approached the border of the sun, and the annulus was about to be dissolved. When, all at once, (the limb of the moon being at some distance from the edge of the sun) a number of long, black, thick, parallel lines, exactly similar in appearance to the former ones above mentioned, *suddenly darted forward* from the moon and joined the two limbs as before: and the same phenomena were thus repeated, but in an inverse order. For, as these dark lines got shorter, the intervening bright parts assumed a more circular and irregular shape, and at length terminated in a fine curved line of bright beads (as at the commencement) till they ultimately vanished, and the annulus consequently became wholly dissolved.

The time employed in this act of dissolution (if I may so express myself, was about the same as that at its formation: but the rapid and progressive change in the appearances, and their striking character, so riveted my attention again, that I am unable to speak more decidedly on the time occupied, than on the first occasion. The same reason also prevents me from stating the precise number of the dark lines: I should think however that they were not fewer than six nor more than ten. The impression on my mind, from recalling all the circumstances to my recollection, is that there were about eight. They were as plain, as distinct, and as well defined, as the open fingers of the human hand held up to the light.

For the cause of this optical deception I shall not attempt to account. That it does not depend on the instrument employed, or on the eye of the observer, would appear from the concurring testimony of those who witnessed the phenomenon, at various places and with different telescopes and who yet agree in the main facts here stated. The account given by Veitch, who used a 30-inch refractor, coincided exactly with my own, as compared immediately after the termination of the annulus. The description also by Sir Thomas Brisbane, who used a 2-feet reflector, and whom I visited immediately after the eclipse, agreed in all the essential particulars, and differed only in those points on which I had myself some doubt. Mr. Henderson also, who observed the eclipse at Edinburgh with a $4\frac{1}{2}$-feet refractor, noticed appearances very similar to those which I have here described.

I have been the more particular in making these remarks from having observed that in no one of the published accounts which I have yet seen of this eclipse, is any special notice taken of the remarkable phenomena above alluded to: although, as I shall presently shew, those phenomena, being seen under different circumstances at different places, must materially affect the astronomical results. Or, if any notice has in some instances been taken, the allusion is so slight (being confined principally to the formation of the string of luminous beads, at the very commencement of the annulus,) that few readers would suspect that any thing further remarkable had occurred. I cannot account for this general reluctance to record so singular a phenomenon as that of the dark lines, which

I apprehend could not possibly have passed unobserved by any astronomer.

There is, however, another extraordinary phenomenon, usually accompanying annular eclipses, of a totally different kind from that just described and arising from a totally different cause; and which takes place immediately before the whole body of the moon is projected on the face of the sun. I allude to the arch of faint light, or rather to the luminous edge, which encircles that portion of the moon's border that is *off* the sun's disc. This has been seen on several occasions, as I shall more fully detail in the following pages; but I must confess that I did not myself observe this phenomenon in the present eclipse: a circumstance owing, in the first place, to my attention not having been specially directed to it; and secondly, to my whole time being occupied in looking out for the distinct formation of the annulus. So many interesting objects indeed are crowded into such a short space of time, just at that instant, that there is no opportunity of noting down appearances during their actual occurrence: and the memory must be taxed afterwards for the recollection and description of minute details.

I have already stated that, from the accounts given of preceding annular eclipses, I was led to expect some extraordinary appearances. To those accounts I shall now more particularly refer, not only as confirmatory of what I myself observed on this occasion, but also to shew the imperfect manner in which the phenomenon has been hitherto described, as well as the variety of forms it may assume according to circumstances either accidental or local. For, the position of the spectator, with respect to his distance from the central line, will doubtless cause a difference in the formation, progress, and whole appearance of the phenomenon. A person placed just within the limits of the moon's umbra would probably not witness any of the dark lines to which I have so frequently alluded: but the border of the moon, which in such case just grazes the edge of the sun, would perhaps have a serrated appearance, like lunar mountains of extraordinary height and magnitude; for which indeed they might be readily mistaken at first sight: or would perhaps exhibit only the luminous string of beads, or broader luminous spaces, throughout the whole progress and existence of the annulus. And thus we might have, from this almost imperceptible and unobservable annular appearance, all the intermediate grades up to the extraordinary phenomenon which I have above described. Intervening clouds likewise, just at an unfortunate moment, may in some cases have prevented a full and connected view of each minute occurrence: a circumstance which may in some measure account for the partial and imperfect statements which have hitherto appeared. And I cannot but consider myself as extremely fortunate in having experienced so fine a day for witnessing the whole of the phenomena which I have here recorded.

Before I quit this part of the subject, I wish here to place also on record the appearances which the body of the moon presented during the existence of the annulus. Previous to the formation of the ring, the face of the moon was perfectly black; but on looking at it, through the telescope, *during the annulus*, the circumference was tinged with a reddish purple colour, which extended over the whole disc, but increased in density of colour according to the proximity to the centre; so as to be in that part nearly black. At the same time the globular form of the moon was very perceptible. Mr. Veitch noticed the same circumstances; and we both agreed that the moon

had the appearance of a *globe* of purple velvet. No coruscations were visible on the darker parts, as noticed on former occasions by different observers. During the annulus, being very near sighted, I could not perceive the moon on the face of the sun, with my naked eye: but to Mr. Veitch and others it was distinctly visible.

It is not known at the present day whether, in the annular eclipses of 1736-7, 1748, and 1764, or even in the recent annular eclipse of May last, the times of the moon's total ingress on the sun's disc, be reckoned from the moment when the moon's circumference appears to osculate with that of the sun, or from the moment when the dark lines are seen to part asunder. I believe that most observers have assumed the latter as the most certain and best determined instant of time; although it seems to me not to be the correct moment of the astronomical phenomenon: the former is in my opinion as easily determined if the observer would prepare himself for noting it, and certainly approximates most nearly to the correct time. My own record of the formation and dissolution of the annulus, in page 154, refers to the point of time here alluded to; namely, when the limb of the moon osculated with that of the sun, as nearly as I could estimate and call to mind, amidst the rapid succession of interesting phenomena; and which I consider to be simultaneous with the formation of the luminous string of beads. Both instants, however, ought to be recorded, as in the case of the transits of *Venus:* and in future annular eclipses (as well as in total ones) I trust that this will be attended to. But, the interposition of clouds will sometimes frustrate the best intentions.

This precaution will be the more necessary, since it is plain that the appearances will be different to different observers, according to their local position with respect to the central line of the moon's shadow; as I have already noticed in the preceding part of this paper. And I know some persons who did not notice the dark lines in the late eclipse, although furnished with good telescopes, and favourably situated. This brings me to another portion of the subject to which I have not alluded, namely the distortion of the moon's circular shape: for, hitherto I have considered the phenomenon as remarkable only for certain filaments or projections from the moon's limb, without supposing that the general circular form of the moon was disturbed. In the case of the transit of *Venus*, we have seen that the disc of the planet, next to the edge of the sun, was sensibly protuberant, and that the form of the planet was thus rendered more like that of an egg, than a circle. The same cause that produced this apparent distortion of *Venus'* disc, might also produce a similar distortion in that of the moon; but, by reason of the magnitude of the moon's disc, and the field of the telescope not embracing the whole, it would not be so easily perceptible. There was one circumstance, however, connected with this subject, which I noticed during the late eclipse, that induces me to think that such a distortion did take place on that occasion, and which I shall now proceed to describe.

If we examine the relative curvatures of the circles in fig. 3, which represent the discs of the sun and moon, and note their proximity to each other, it will be seen that there can be no very perceptible difference in the apparent length of the parallel lines, which there denote the dark ligaments so frequently alluded to in this paper, provided those curves truly represented the apparent disc. But, in fact, the outer lines immediately before their rupture seemed to be nearly twice the length of those in the middle, which could arise only from some distortion of the moon's apparent

limb, and of a kind similar to that which had been observed in *Venus.* I have endeavoured to represent this appearance in fig. 4: and if my notion be correct, it will shew us that all measures of the moon's diameter, when she is passing over the sun's disc, must be taken with great caution and with due attention to the proximity of the part measured to the edge of the sun's disc, where alone the distortion seems to take place.

This hypothesis of a distortion of the moon's circular form seems to receive confirmation from a circumstance attending her motion across the sun's disc, when she is *wholly* thereon, which has been noted in annular eclipses by several observers: namely, that at the time of ingress and egress, her motion appears more rapid than at any other point. This apparent increase of motion would arise from the subsidence of the protuberance in the first nstance, and from its projection in the latter case.

Another singular anomaly also may arise, from this view of the subject. It is possible that in a small annular eclipse (that is, an eclispe where the apparent diameter of the moon, as computed from the tables, is but a few seconds less than the apparent diameter of the sun) the observer may be so exactly placed on the central line as to see the eclipse *total,* for a moment of time. For, as each portion of the moon's circumference would at the instant that it was concentric with the sun's) protrude, and adhere to that of the sun, the spectator would witness a total eclipse *sine mora,* when in fact he ought only to see an annular one.

It is very probable that the accounts of the appearance of great lunar mountains and valleys which we so frequently hear of in the descriptions of solar eclipses, may be traced to the same cause, as that which produces the phenomena above alluded to. These prodigious elevations and depressions are seldom or never seen except at the commencement or termination of the eclipse, or in places near the solar cusps; that is, in those points only which are near the edge of the sun. Every other portion of the moon's circumference generally appears comparatively smooth and circular, except viewed with a very powerful telescope; whilst with a much inferior instrument we may frequently detect inequalities in those parts of the moon's circumference which successively come in contact with the sun's limb.

This brings me to the consideration of another subject connected with the present inquiry. It has, I believe, been generally supposed that, in eclipses of the sun, the measurement of the distances of the solar *cusps* affords one of the best means of determining the beginning and ending of the eclipse: and, if those cusps always presented a finely pointed apex, this would undoubtedly be the case. But, it is frequently found that the cusps are rounded, or serrated, or broken into parts, and consequently that we cannot obtain the correct measures between the *true points* of the cusps. For which reason we oftentimes meet with discordances in such measures, that have hitherto baffled all attempts at explanation; but which may be fairly attributed to the causes above alluded to. I do not wish however to be considered as objecting to this mode of determining the phases of an eclipse, which, after all, is probably one of the best: but merely as wishing to place the observer on his guard, and to enable him to trace the source of error, should he meet with any of the discordances above mentioned.

It is clear that, before we can deduce the most accurate and accordant results from the observations of annular eclipses, we must have further information on these points, and we must agree on the particular stage of the phenomenon, when the annulus shall be considered as formed, or dissolved: and after all, there will probably still remain some discrepancies arising from the distortion of the moon's limb according to the geographi-

cal position of the spectator. The subject, however, is worthy the consideration of astronomers; and ought not to be neglected at any ensuing solar eclipse that may afford facilities for determining these points.

Franklin Institute.

REPORT OF THE COMMITTEE ON METEOROLOGY.

Report of the Committee on Meteorology to the Board of Managers of the Franklin Institute, embodying the facts collated by the Meteorologist relative to the storm of the 16*th*, 17*th and* 18*th March*, 1838.

As the great storm immediately preceding the Vernal equinox of the present year was one of that class which is supposed to stretch over a wide extent of territory, and to traverse the globe with a determinate direction and velocity, it was believed that an accurate knowledge of its progress and violence at different points would not only prove highly interesting to the cultivators of Meteorological knowledge, but would also tend much to the promotion of the object for which the committee was appointed; with this view the late Joint Committee on Meteorology, of the American Philosophical Society and of the Franklin Institute, issued two hundred and fifty circulars to different parts of the United States and to Canada, asking for information on the various phenomena exhibited by the storm in the respective vicinities.

That the persons addressed might know the precise objects which the committee had in view, it was stated in the circulars, that the committee regarded it as highly important to ascertain the phases of the great storms of rain and snow which traverse our continent, their shape and size, what direction, and with what velocity their centres move along the surface of the earth, whether they are round, oblong, or irregular, in their shape, whether they move in different directions in the different seasons of the year, &c. &c.

To this circular between forty and fifty answers have been received, furnishing a mass of information highly useful and interesting.

These communications were placed in the hands of the Meteorologist for collation, which duty he has performed, as will be seen by his report annexed.

Robley Dunglison, M. D.
Alexander D. Bache,
James P. Espy,
Charles N. Bancker,
John K. Kane,
Henry D. Rogers,
Sears C. Walker,
R. M. Patterson, M. D.
John C. Cresson,
Gouv. Emerson, M. D.

Philadelphia, July, 9th 1838. Committee on Meteorology.

TO THE COMMITTEE ON METEOROLOGY OF THE FRANKLIN INSTITUTE.

Gentlemen:—The following facts comprise some of the most important details collected from the various correspondents. These with additions from other sources are arranged and numbered so as to commence in the Westward, and progress towards the Eastward.

Franklin La. (S. W. of New Orleans,) 29° 50′ N. 91° 50′ W. (From our regular correspondent, a lady.)

Beyond the storm. On the 16th, 17th, 18th and 19th of March, the wind was constantly from the N. high in the mornings, light in the evenings, except the 19th, when it was light in the morning. Clear from the 14th till the afternoon of the 22nd. Slight frost on the 18th and 19th. Barometer rose from the 16th 30.20, till the 17th 30.30, and remained at that till the 20th when it fell again to 30.20.

2. U. S. Hospital, Baton Rouge, La. 30° 29′ N. 91° 27′ W. Observed by W. R. Heipers, and communicated by A. Waddeir, Esq.

There was no storm here on the 16th and 17th of March, which were clear fine days, wind strong from N. E. 18th fine clear day, frost, wind light N. W. 19th wind N. W. strong, cloudy.

3. Natchez, Miss., 36° 34′ N. 91° 25′ W. (From our regular correspondent, Henry Tooley, Esq.)

March	16th hazy, but without a cloud, wind	N.	2	3	6	
	17th hazy, very clear "	N. W.	2	3	4	2
	18th not a stain on the ethereal blue,	N.	2	W	1	
	19th thick haze.	S.	2	SW.	2	1

Barometer on the	16th	29.91
	17th	30.03
	18th	30.05
	19th	29.95

4. Jackson, Miss., 32° 23′ N. 90° 8′ W. (Communicated by the Postmaster.)

There was no rain here from the 11th of March till April.

March 16th, wind's direction and force	N.	2	6	3	
17th, ...	NW.	2	3	4	2
18th, ...	N.	2	W.	1	
19th, ...	S.	2	SW.	1	

5. U. S. Frigate Constellation, Pensacola Bay, lat. 30° 23′ 40″ N., long. 87° 12′ W. (Observed by Dr. Hulse, and communicated by J. H. C. Coffin, Esq.)

This place was beyond the borders of the storm. On the 16th, 17th and 18th of March, the wind was from WNW. to N. and NW. constantly; generally moderate weather; clear, with haze in horizon.

On the 19th the wind was NW. till noon, changeable P. M. to southwardly.

6. Huntsville, Alabama, 34° 36′ N., 85° 57′ W. (From John Allan, Esq.)

We had no storm here at the time mentioned. On the 15th, 16th, 17th and 18th of March, the wind was moderate from the NW. Weather cloudy, with the exception of the 18th, which was clear. On the 19th the wind in the morning was a stiff breeze SE., the remaining part of the day SW.

7. Nashville, Ten., 36° 10′ N. 86° 49′ W. (From our regular correspondent, Morgan W. Brown, Esq.)

March 14th, some rain, with change of wind from S. and SW. to NW.

15th, cloudy, clouds passing from N. with moderate wind.

16th, cloudy, with slow rain in forenoon, and occasional showers in the afternoon, mixed with sleet—clouds passing from NW. with brisk wind; becoming colder.

17th, Clouds passing from NW. and N., with brisk wind from NW., partially clear at sunset and after night.

18th, clear, except cirri to E. in the morning, which soon passed off in that direction; wind brisk throughout the day NW.; calm at night.

8. Grayville, Illinois. (From James Gray, Esq.)

The weather here on the 16th, 17th, 18th and 19th, was good, except that there may have been a little rain. The wind was, during that time, too gentle to be observed, and therefore I cannot say from what quarter it came.

9. Warren Court House, Illinois, on the Mississippi river, pretty high up, 40° 50′ N., 90° 50′ W. (From Daniel McNeily, Esq., P. M.)

We had no storm here. The sky was remarkably clear, and fine weather on the days mentioned, if our memory serves us. On the night of the 15th we had a little snow, and for a few days after a light wind from NW.

10. Logansport, Ind., (near northern part of the state,) 40° 53′ N., 86° 22′ W. (From D. D. Pratt, Esq.)

On the 16th, 17th, 18th and 19th of March, the weather here was remarkably fine and warm, and continued so till the 8th of April.

I recollect, however, on the night of the 15th, and during the forenoon of the 16th, a heavy damp snow fell to the depth of several inches, accompanied with a strong wind. I was riding down the Wabash in a direction a little south of west, and I think the wind was blowing nearly in my face. It might have been from a point 25° or 30° south of west.

11. Elizabethville, Harrison county, Ind. (From E. H. Compton, Esq., observed by John Low, Esq.)

March 16th, got up before sunrise, found a rainy morning, which early in the day changed to snow, and was attended with the severest storm felt here this season. The snow, notwithstanding the dampness of the ground, fell three or four inches deep. The storm continued till I went to bed at 8, P. M.; wind from the NNW., the point from which it blew all day.

17th, left my bed at day break, found it still cloudy, with considerable wind. It was partially clear through the day, and the wind came round to NNE.

18th, at day break, found it clear, but somewhat cold; moderated, became pleasant, and remained so all day, and wind changed to ESE., quite calm.

12. Lexington, Ky. 38° 6′ N., 84° 18′ W. (From our correspondent, Prof. Robert Peter.)

	Bar.	Bar.	Bar.	Ther.			
March 16th,	29.02	28.97	29.00	45°	41°	36°	Rain, sleet, wind very high in the night NW.
17th,	28.86	29.00	29.02	30	34	36	Snow, windy, N. winds at night.

	Bar.	Bar.	Bar.	Therm.			
18th,	29.01	29.02	29.02	36	50	40	Clear, more clear.
19th,	28.98	28.88	28.85	40	65	57	Hazy, clear.

Rain 0.05 on night of the 15th.
" 0.40 on " 16th.
" 0.10 on " 17th.

Whole amount, 0.55 of an inch.

The wind, if my recollection serves me, was at its height on the night of the 16th, NW., and was still high on the 17th, N.

13. Wilmington, O. (a little north from Cincinnati,) 39° 30′ N., 84° 53′ W. (From A. Jones, M. D., by Hon. P. G. Goode.)

It commenced raining at noon on the 13th of March, and continued rainy until noon of the 16th, at which time it snowed and rained alternately. But a small quantity of rain fell. On the 17th, snow from a half to one inch deep. The wind on the 16th, 17th, 18th and 19th, was NW., and a good part of the time a strong current. On the 17th and 18th, very strong current NW.W. The morning of the 18th was clear, and continued so till the 23d, at night, when there was a slight rain.

Troy, O., (80 or 90 miles N. of Cincinnati.) (From John G. Talford, Esq.)

On the night of the 16th of March, and also on the night of the 17th, we had a slight fall of rain and snow, (mixed.) The 18th was a clear, warm, and pleasant day, and I find noted, the honey bee out this day for the first time. On the 16th the wind was NW., not strong; and on the 17th and 18th it was N., gentle. The thermometer ranged from 26° to 70°.

14. Springfield, O., 39° 30′ N., 84° 50′ W. (From our regular correspondent, M. G. Williams, Esq.)

Began to rain at 6½ A. M. of the 16th March, changed to snow at 9, and terminated at night, 0.23 inch of water. Wind all day at N. 2, clouds NNW. 2. On the 15th the wind was NW. 3-2 all day, and on the 17th it was NW. 3 at 7 A. M., and at 2 P. M., NNW. 4; clouds N. 2, and at sunset NNW. 3; cloudy all day. 18th, clear; wind all day NNW. 2-3-1. The barometer was, on the 15th, 28.95, and fell to 28.86 on the morning of the 17th, at which it stood all day, and rose again on the 18th to 28.90, but fell very rapidly on that day to 28.63.

15. Greenfield, Ind., (near the middle of the state,) 39° 53′ N., 85° 52′ W. (From our regular correspondent, David Alter, Esq.)

March 15th, cloudy; light breeze from NW. and occasionally a sprinkle of rain. 16th, breeze from the N. and some snow falling. 17th, clear, strong wind from N. 18th, clear, light breeze from N.

Rome, Ind., 37° 58′ N. 86° 32′ W. (60 miles SW. of Louisville.) (From Samuel Frisbie, Esq.)

We had no storm of rain or snow during the days named. Indeed, previous to the 6th of April, we had no rain for a long time, and the Ohio bottoms became very dry and hard to plough. I must say, however, I took no note of the weather, and I rely solely on my recollection.

16. Washington, Michigan. (From D. Cooley, Esq., P. M.)

March 15th, cloudy. 16th, snowed moderately through the day; amount

of snow two inches; wind brisk from NE.; clear at 9, P. M. 17th, 18th and 19th, clear; wind not noted.

Centreville, Michigan, (Southern part of the state, and nearer the west than the east.) (Observed by Wm. Connor, Esq., communicated by J. W. Lawley.)

March 16th, at 4½, A. M., commenced snowing, heavy wind NW.—cold—at noon stopped snowing; depth of snow two inches. The 17th, clear and pleasant; snow gone at noon. 18th, clear and warm. 19th, thermometer 66° in the shade.

17. Western Reserve College, Hudson, O., (NE. corner.) (From our correspondent, Prof. Elias Loomis.)

March 15th, dense drizzling fog, wind faint from NW. 16th, wind light from NW. to NNW., with some snow and drizzling. 17th, wind fresh in the morning, strong in the afternoon from N., varying from about NNW. to NE., (March wind.) 18th, perfectly clear and bright; wind light from NNW. to N. The barometer was nearly stationary on the 16th and 17th, at about 28.86; on the 18th it fell to 28.79, and on the 19th to 28.47.

18. Jefferson, N. C., (Northwest corner of the state,) 36° 30′ N., 81° 20′ W. (From R. Murchison, Esq.)

The storm commenced here some time in the night of the 15th of March, with rain strongly driven by W. and NW. winds, and terminated on the 18th in the afternoon. The wind blew with little variation from W. and NW. much of the time with great velocity.

There was considerable rain on the night of the 15th and on the morning of the 16th; and about noon on that day a furious storm of snow commenced that continued till about (or a little before) 12, M., on the 18th. The whole of the 17th was the most constant and violent snow storm I ever saw to continue so long.

It is difficult to state the precise depth of the snow. I presume it would have averaged say 18 or 19 inches deep, if the wind had not blown so as to drift it.

It was very cold during the storm; range of mercury, from 25 to 8 above zero.

19. Charleston, S. C., 32° 47′ N., 79° 57′ W. (From our correspondent, Ed. C. Keckeley, M. D.)

March 16th, wind south—rain.
17th, wind south—cloudy.
18th, wind NW.—fair.
19th, wind NW.—fair.

The rain of the 16th was very trifling. Since then to this time, (3d of April,) we have had no rain. During the whole of the month of March we have had very little wind; indeed, the atmosphere has been close and sultry.

20. Newbern, N. C. 35° 20′ N. 77° 5′ W. (From Wm. G. Bryan.)

Clear, and pleasant, and calm, on the morning of the 16th. Light wind in the afternoon at south. On the 17th, cloudy and warm. Light rain before day, wind at south. Afternoon cold and cloudy—rain and hail—wind west. On the 18th, cold and cloudy, moderate wind at NW. The 19th

was clear and cold, moderate wind W. 20th, very pleasant—smoky—wind SW.

21. New Garden, N. C., (eight miles NE. of James Town,) 34° 57′ N., 79° 10′ W. (From Jona. L. Slocum, communicated by David Lindsay, Esq.)

On the 16th the weather was cloudy and damp during the day, in the evening some thunder and rain; wind NE. all day. On the 17th, cloudy in the morning, and in the afternoon and evening rain falling, mixed with snow; wind NE. On the 18th, wind NW. till evening, then NE.—cloudy—snow nearly two inches deep. 19th, wind NW. all day, clear and pleasant.

Smithville, N. C., (SE. corner of the state,) 34° 7′ N., 78° 10′ W. (From G. S. Jewett, Esq.)

March 16th, clear and fine; wind SW. probably light. 17th, clear, cold and windy, WSW. 18th, cold, a little rain, windy, NW. Also, 20 miles above Smithville, March 16th, pleasant day; wind SW., very fresh about 1, P. M. 17th, wind not high this day. 18th, not known. 19th, wind NW., pleasant.

22. Alexandria, D. C., 38° 49′ N., 77° 4′ W. (From our correspondent, Wm. E. Harper, Esq.)

The storm commenced on the 16th, and terminated on the evening of the 18th.

The wind blew constantly from the NE. strong on the 16th, 17th and 18th, and there was considerable rain, snow, and hail on the 17th, continuing till noon of the 18th.

On the 19th, wind strong from NW. The thermometer at freezing point before sunrise.

23. Capitol Hill, Washington City, 38° 53′ N., 77° 2′ W. (From our correspondent, Dr. J. M. Foltz, of U. S. Navy.)

The wind on the 16th of March was SE., and light; On the 17th, a strong gale from NE. On the 18th, NE., fresh, and on the 19th, NW., moderate.

At 9 o'clock, on the 17th, it was raining, and had rained $1\frac{1}{100}$ inch; it rained and snowed two inches on the 17th and on the 18th, $\frac{8}{10}$ inch more; making in all 3.81 inches. The barometer was stationary on the 16th at 29.93. It fell by 9 A. M. of the 17th, to 29.758, and at 3 P. M. it was down to 29.60, and was the same next morning.

Dr. Foltz infers, from the great severity of the storm, and from the quantity of rain and snow accompanied with a strong NE. gale, that he was, at Washington, in the centre of the storm.

24. St. John's College, Annapolis, Md., 20° 0′ N., 76° 43′ W. (From our regular correspondent, Prest. H. Humphrey.)

The storm was of great violence, and as far as I know blew steadily from the NE. When I rose on the morning of the 17th of March, it was raining moderately, and I observed the Barometer had fallen from 30.00 to 29.76. It continued to sink all day, and at 6, P. M., was 29.62, and on the morning of the 18th, at 7, was 29.59.

My opinion is, that the wind began to blow about 11, P. M. of the 16th,

at which time I observed a remarkable light, due E., that I took to be an aurora. I watched it for some time after my lamp was extinguished, and it exhibited vivid pencils, as high as 45° or 50°, and cast a strong light, although obstructed by broken clouds. It was soon after this that I noticed the raising of the wind, by its effect on the building. The rain on the 17th turned to snow in the afternoon, which continued through some part, or all of the night, but the quantity was small, leaving but two or three inches on Sunday at noon. The rain fell in torrents, and the gale blew at times as powerfully as I have ever felt it at this place. Its violence abated somewhat on Sunday afternoon.

25. Gettysburg, Penn., (south side of the state.) (From our regular correspondent, Jacob Lefever, Esq.)

The storm commenced with dribbling of rain at 10½, P. M., March 16th, and the heavy fall of snow terminated about 9½, A. M., on the 18th, although there were frequent showers of fine snow till about 5½, P. M. The morning of the 19th was very nearly clear and calm. The wind was NNE., that is, nearer N. than NE. all the time. It commenced with rain; but on the morning of the 17th, the snow was ¾ inch deep, and melting very fast. The whole quantity fallen I calculated at 1.7473 inches. The snow along the mountain, within ten miles of this place, was said to have been at least 2½ feet deep.

The wind was from 2 to 3 from the evening of the 16th till the evening of the 18th. That is, a strong breeze.

26. Bellefonte, Penn., (near the centre of the state,) 40° 54′ N., 77° 47′ W. (From our regular correspondent, John Harris, M. D.)

The snow commenced at 10, P. M., of the 16th, and continued till 4, P. M., of the 18th, being a great part of the time mixed with rain; its depth about 7 inches—whole quantity estimated at 1.5 inches of water.

The wind was N. at 7 A. M. of the 16th and gentle; from 2, P. M., of the 16th, till 7, A. M., of the 19th, the wind was constantly very gentle from NE., when it changed to SW. Barometer all day of the 16th, 29.29; at 7, A. M., of the 17th, 29.25; at 2, P. M., 29.24; at 9, P. M., 29.20.

27. Meadville, Penn., 41° 38′ N., 80° 10′ W. (From our regular correspondent, Frederick Huidekoper.)

	Thermometer.			Barometer.			Direction & force of wind.		
Day.	7 A.M.	2 P.M.	9 P.M.	7 A.M.	2 P.M.	9 P.M.	7 A.M.	2 P.M.	9 P.M.
March 16	33°	36½°	29°	$\frac{0}{28.85}$	$\frac{0}{28.83}$	$\frac{0}{28.85}$	N. 1	N. 2	N. 4
17,	29	34	33	$\frac{0}{28.83}$	$\frac{0}{28.83}$	$\frac{0}{28.84}$	ENE. 4	E. 5	E. 3
18,	27	45	27	$\frac{10}{28.82}$	$\frac{10}{28.81}$	$\frac{10}{28.77}$	ENE. 4	ENE. 5	0

On the 16th, snow too slight to be measured.

28. Rochester, N. Y., 43° 8′ N., 77° 51′ W. (From John B. Elwood, Esq.)

	10 o'clock, A. M.				10 o'clock, P. M.			
	Ther.	Bar.	Wind.	Sky.	Ther.	Bar.	Wind.	Sky.
March 15th,	48°	29.60	S.	Cloudy.	40°	29.60	W.	Cloudy.
16th,	37	—.70	NE.	do.	32	—.75	NE.	do.
17th,	36	—.80	E.	Fair.	37	—.75	E.	Fair.
18th,	43	—.65	E.	do.	34	—.50	NE.	do.
19th,	35	—.30	W.	do.	43	—.35	E.	Cloudy.
20th,	32	—.30	NW.	Cloudy.	38	—.60	NE.	do.
21st,	34	—.70	NW.	Showers.	50	—.60	SW.	Showers.

The winds were at no time very strong, or a note would have been made of it.

29. Onondaga Hollow, N. Y., (middle of the State,) 43° 0′ N., 76° 6′ W., nearly. (From J. L. Hendrick, Esq.)

We had no storm here except a small snow storm on the afternoon and evening of the 16th of March; the wind NW. all day. On the 17th, the wind somewhat variable, generally N., (A. M.) and N., NNE. and NE., (P. M.;) cloudy all day. On the 18th, wind N. and NNW. (A. M.) and NW (P. M.;) day cloudy. On the 19th, wind variable, but generally W.; day fair. The strength of the wind during those days was also variable; sometimes, and especially from the W. and NW., rather strong, at other times only a gentle breeze.

30. Silver Lake, Penn., 41° 55′ N., 76° W. (From our regular correspondent, a lady.)

	Thermometer.			Barometer.			Winds.		
Day.	7.AM.	2 P.M.	9 P.M.	7 A.M.	2 P.M.	9 P.M.	7 A.M.	2 P.M.	9 P.M.
March 16,	36°	38°	36°	$\frac{0}{28.00}$	$\frac{0}{27.98}$	$\frac{0}{27.98}$	SSE.2	S3.	S2.
17,	32	38	34	$\frac{0}{28.00}$	$\frac{0}{28.00}$	$\frac{0}{28.00}$	NW.2	NW.2	NNW.2
18,	31	42	58	$\frac{10}{28.00}$	$\frac{10}{28.00}$	$\frac{10}{28.00}$	NW.1	NW.2	NW.3

On the night of the 16th it snowed one inch deep, and on the 17th, it snowed half an inch.

31. Sunbury, Penn., 40° 53′ N., 79° 50′ W. (From our regular correspondent, Hugh Bellas, Esq.)

	Thermometer.			Barometer.		
	8 A.M.	Noon.	5 P.M.	8 A.M.	Noon.	5 P.M.
March 16th,	41°	49°		29.45	29.45	
17th,	34	37	36°	29.45	29.45	29.45
18th,	32	38	36	29.30	29.30	29.30

On the night of the 16th snow six inches deep; on the mountains between this and Pottsville, three or four feet deep—no mails for seven days.

Snow, rain and snow, on the 17th, and on the morning of the 18th, the wind NE., on the 16th, 17th, and 18th, except at 8 A. M. of the 17th, when it was E. On the 19th changeable from NW. to SW.

32. Bucks County Academy, Penn., 40° 17′ N., 75° 7′ W., nearly. (From our regular correspondent, Prof. L. H. Parsons.)

	Thermometer.			Barometer.			Winds.		
	7 A.M.	2 P.M.	9 P.M.	7 A.M.	2 P.M.	9 P.M.	7 A.M.	2 P.M.	9 P.M.
March 16th,	44°	56°	43°	$\frac{29.92}{1}$	$\frac{29.82}{2}$	$\frac{29.81}{0}$	NE.½	NE.½	NE.½
17th,	37	35	33	$\frac{29.87}{0}$	$\frac{29.81}{0}$	$\frac{29.73}{0}$	NE.½	NE.2	NE.3
18th,	32½	34½	33	$\frac{29.60}{0}$	$\frac{29.65}{0}$	$\frac{29.65}{0}$	NE.2½	NE.1	NE.1

It rained on the night of the 16th; depth of snow, 5 inches in all; ceased on the night of the 17th. Snow and rain, 2.48 inch water.

33. Reading, Penn., 40° 18′ N., 75° 55′ W. (Observed by C. F. Egelmann, Esq., communicated by Saml. Ritter, Esq.)

March 16th, cloudy, with NW. wind at 2, P. M. Temp. 62°. 17th,

rain at 7, A. M., turning to snow at $7\frac{1}{2}$; snow continued, with occasional rain, till the morning of the 18th, wind strong from NE. all the time; in the evening it changed round to NW., and was NW. and W. next day. On the 17th, the thermometer was from 34° to 33° all day.

34. Philadelphia, Penn., 39° 57′ N., 71° 11′ W. (By James P. Espy, Meteorologist of Joint Committee.)

March 16th, wind very gentle N., and clouds from SW. 1, and cloudy at 7, A. M.; wind got round to NE. 1 before 2, P. M., clouds still coming from SW. 2; a slight sprinkle of rain at 9, P. M.

17th. On the morning of the 17th, at 7, it began to rain, mingled with hail; it rained much during the morning, and snowed much in the afternoon, wind and clouds from NE.; storm increasing in violence all day, and continued very violent all night, until 9, A. M., of the 18th, when it began to abate, and at 1, P. M., it had nearly ceased snowing; wind still very strong N. E. A little snow in the afternoon, and by 6, P. M., the wind had veered round to N. by E., and gradually died away in the night; and on the morning of the 19th it was, with the lower clouds, N., very gentle, and the upper clouds from the west, moving quite slow.

The barometer was stationary on the 16th, at 29.91, and fell on the 17th, from 29.93, at 7, A. M., to 29.78, at 9, P. M., and was at its lowest, 29.68, on the next morning. The thermometer ranged from 44° to 55° on the 16th; from 37° to 33° on the 17th, and was only 33° at 2, P. M. The dew point was 38°, or 17 degrees below the temperature of the air on the 16th, at 2, P. M.; and at 2, P. M. of the 17th, it was almost the same as the temperature of the air itself, or 33°.

Greendale, Penn., (west of the centre of the state.) (From our regular correspondent, H. B. Wright, Esq.)

March 16th, calm, clouds from N., small rain P. M., cloudy all day. 17th, calm till 11, A. M.; snow all day and all night till 9, A. M., of the 18th; clearing at 6, P. M., with fog in the night.

Wind NE. on the 17th; calm again on the 18th; warm on the 20th, with high waters. Whole quantity of water deposited, 68.100.

35. Snow Hill, Md., (Eastern Shore, southern part,) 38° 10′ N., 75° 25′ W.

On the morning of the 16th, appearances of rain; at 4, P. M., raining, wind nearly calm, NE. On the 17th, at 8, A. M., rain—wind ENE. 4; it rained all day, wind NE. 5, and continued to blow hard all night, frequently raining hard. Towards day on the 18th, it became moderate, and at 11, A. M., wind was N. 4, still cloudy and dark; at $5\frac{1}{2}$, wind N. 4, rain, mixed with snow. On the 19th, in the morning, the wind was west, and moderate; at 4, P. M., it was northerly and clear.

36. Log Book of ship Algonquin, near Delaware Capes.

March 16th, noon, civil reckoning,—Light airs from WSW., and clear; at 1, P. M., calm; at 6, P. M., light airs from E.; sounded in 50 fathoms water; midnight, strong breezes from E. by N., and hazy; at 4, A. M., strong breezes and rain; 35 fathoms water; at 5 took in top gallant sail; double reefed the mizen top sail; at 7 double reefed the fore and mizen top sail, took in the jib; at 8, strong gales, and thick rainy weather; 18 fathoms water; wore ship's head to SE., [to avoid coming on shore;] at 11, A.

M., gale ENE., increasing; moderately strong, and a high sea; raining very heavy; sounded 22 fathoms water; continuing with strong gales NE. by E.; heavy squalls and torrents of rain; bearing a heavy press of canvass to get off shore; at 4, P. M., took in main sail; 23 fathoms water; at 6, P. M., 30 fathoms water; took in fore topsail; *at* 10 *minutes past* 6, *fell start calm;* left a very heavy sea; midnight *calm*; cleared off; very heavy swell; at 2, A. M. of 18th, light air from south, set the fore sail and fore top sail; shut in thick; at 4, A. M., light airs and thick weather; at 5, A. M., set single reefed top sails, jib, and spanker main sail, wind still south; at 8, set the top gallant sails; thick weather; noon, moderate breezes, wind baffling.

Batavia, N. Y., (near NW. Corner of the state,) 42° 58′ N., 76° 20′ W., nearly. (From W. H. Webster, Esq.)

Wind on the 16th, 17th and 18th of March, fine acicular crystals of snow falling all day of the 16th, but now lying on the ground. Sun seen through the clouds all day on the 17th.

37. Catskill, N. Y., 42° 10′ N., 73° 52′ W. (From the Postmaster.)

Between the 16th and 19th of March, about 3 inches of snow fell; wind southerly at first, soon veering about SE., N. and NW.; a heavy gale on the 18th and 19th, wind northerly.

38. Pottsdam, N. Y., 44° 38′ N., 74° 59′ W. (From David S. Shelden, communicated by H. Allen, Esq., P. M.)

March 16th, wind all day N., with a little snow in the morning. On the 17th, cloudy in the morning, clear in the afternoon; wind all day NE., light. On the 19th, clear in the morning, a little rain in the afternoon; wind NE. in the forenoon, and SW. in the afternoon, very light.

39. Montreal, Canada, 45° 31′ N. 73° 35′ W.

From the Journal of James McCord, Esq. it appears that it neither rained nor snowed here during 16th, 17th, 18th, 19th or 20th of March, and the wind blew steadily, but not violently, from the North, on the 16th, 17th, 18th and 19th, and on the 20th shifted to the N. W.

The Barometer stood as follows:

16th,	morning,	30.040	evening	30.124
17th	"	30.250	"	30.200
18th	"	30.088	"	29.890
19th	"	29.678	"	29.464
20th	"	29.724	"	29.750

The mean of the maximum and minimum of the thermometer, during those days was 31° and 8°.

The mornings were generally clear and fine, growing cloudy towards the evening. The strength of the wind may be called a *fresh breeze.*

40. University of Vermont, Burlington, 44° 30′ N., 73° 12′ W. (From Prof. Geo. W. Bluedict.)

There was no storm here of any kind during the days in question. The whole month of March, previous to that time, was remarkable here for its mild and quiet character. East winds are almost never known here.

Though I made no record of the wind on the days mentioned in the circular, I am confident that the set of the air (quite slight) was from the south, and the weather pleasant.

41. Charlestown N. H. 43° 14′ N. 72° 25′ W. Dr. S. Webber.

March 16th, wind N. E. cloudy, broke away partially for a little while about noon shewing many broad streaks of cirro-strati—in the afternoon, sky again overcast looking like rain, Therm. 34°.

17th, wind N. E., cloudy through the day—at noon wind became E. but changed again to N. E., Therm. 36°.

18th, wind N. E. fresh and raw, about 11 A. M. began to snow which continued moderately through the day, Therm. 29°.

42. Jafrey, N. H., S. W. corner of the State, 42° 45′ N. 72° 5′ W.

L. Howe, Esq. informs us that there was no storm there—only one inch of snow on the 18th, at noon, fair on the 19th. On the 16th and 17th, wind not recollected.

43. Wesleyan University, Middletown, Con., 41° 34′ N., 72° 39′ W. (From our regular correspondent, Prof. Aug. W. Smith.)

On the morning of the 16th, at 7½, A. M., the wind was noted NW., the rest of the day N., quite gentle. On the 17th, wind N. at 7½, A. M.; and clouds NE.; at 12, meredian, and 5½, P. M., wind E., and gentle all day; cloudy, with slight rain at 2, P. M. On the 18th, snow about two inches deep all the morning; time of beginning not mentioned; wind NE. all day, and strong. 19th, wind NE., A. M., strong, and NW., P. M., gentle. Barometer rose from 29.81 on the morning of the 16th, to 30.11, at 5½, P. M., of the 17th; fell again till 5½, P. M., of the 19th, when it was 29.70.

44. Newport, R. I., 41° 28′ N., 71° 21′ W. (From our regular correspondent, R. J. Taylor, Esq.)

March 16th, wind from NW. in the morning, and SW. P. M. 17th and 18th, and morning of 19th, NE.; then NW. at 2, P. M., and SW. at 9, P. M.—*heavy on the 17th.*

	7 A. M.	2 P. M.	9 P. M.
March 16th, Barometer	29·65 / 10	29·72 / 10	29·80 / 0
17th, "	29·90 / 0	29·90 / 0	29·86 / 0
18th, "	29·67 / Snow.	29 57 / 0	29 51 / 0

Snow from 6 to 12 inches on the 18th.

45. Brown University, Providence, R. I., 41° 50′ N., 71° 25′ W. (From our regular correspondent, Prof. Alexis Caswell.)

	Barometer.			Thermometer.		
	S. R.	1 P. M.	10 P. M.	S. R.	1 P. M.	10 P. M.
March 17th,	29.90	29.96	29.91	35°	38°	34°
18th,	—.74	—.70	—.60	31	32	28
19th,	—.74	—.45	—.41	28	38	34

		Winds.			Weather.		
		S. R.	1 P. M.	10 P. M.	S. R.	1 P. M.	10 P. M.
March	17th,	NE.	NE.	NE.	var.	cloudy.	cloudy.
	18th	"	"	"	snow.	snow.	snow.
	19th,	"	easterly.	easterly.	cloudy.	cloudy.	clear.

The 15th was mild and pleasant—16th do. and wind came to NE. A. M.; on 17th wind NE. brisk and raw, increasing towards night and cloudy. Wind heavy during the night.

On the 18th snow began to fall about 6 A. M., wind heavy NE., snow continued till after 10 P. M. but ceased before morning. The wind was so violent during the storm, that the snow was considerably drifted; quantity half an inch water.

46. Dedham, Mass., 42° 15′ N., 71° 11′ W. (Journal of Mr. Talbot, communicated by Elisha Thayer, Esq.)

16th, fair, moderate NE. wind.
17th, cloudy, strong NE. wind.
18th, cloudy, very strong NE. wind, with 2½ inches snow.
19th, cloudy, moderate NW. wind.

47. New Bedford, Mass., 41° 37½′ N., 70° 56′ W. (From Richard Williams, Esq.)

		Ther.	Bar.	Wind.	Weather.
March 16th,	sunrise,	37°	30 00	NW. light.	clear.
	2 P. M.	49	30.09	NE. mod.	clear.
	9 P. M.	41	30.18	" "	cloudy.
17th,	sunrise,	37	30.23	" fresh.	"
	2 P. M.	40	30.29	" "	"
	9 P. M.	35	30.26	" high.	"
18th,	sunrise,	34	30.11	" "	beginning to snow.
	2 P. M.	33	29.99	" "	snowing lightly.
	9 P. M.	33	29.91	" fresh.	cloudy, water fallen .60.
19th,	sunrise,	32	29.78	NNE. "	light snow.
	2 P. M.	36	29.71	N. mod.	clouds broken, P. M.
	9 P. M.	32	29.74	westerly, light.	clear. [clear.

Northboro, Mass., 42° 16′ N., 71° 48′ W., nearly. (From Joseph Allen, Esq.)

March 16th. This was a mild, pleasant day, wind SW.; some time during the night the wind shifted into the NE.; and the 17th was raw, cold, and cloudy—wind pretty strong from NE. Early on the 18th, the snow began to fall, and the wind to rise; and through the day the storm continued without intermission, though its violence abated somewhat in the latter part of the afternoon. The snow was quite moist, yet so great was the violence of the wind, that it drifted a good deal, probably about six inches in depth.

Williams College, Mass., (NW. corner of the state,) 42° 30′ N., 73° 12′ W.

President Albert Hopkins states that from the 16th to the afternoon of the 17th, the wind was NW., and then changed to NE.; that it commenced snowing soon after breakfast on the morning of the 18th., wind N., or perhaps a little E. of N. On the 19th, it was from N. to NW., and clear. The thermometer varied only from 30.5° to 39° till the 19th, when it rose to 43°, wind very light.

48. Concord, N. H., 43° 12′ N. 71° 29′ W. From John Farmer, Esq.

The storm was hardly felt here. The weather was cloudy all day, on the 17th of March with the wind E. and N. E. On the 18th a light snow commenced at noon, and continued through the afternoon, enough to cover the ground.

The wind was brisk part of the day, from the N. E. The highest point of temperature during the day was 33° and the lowest 28°.

On the 19th at 9 A. M., all appearances of a storm had ceased, wind N. W. as it had been on the 16th.

The Thermometer stood as follows:—

	6 A. M.	Highest	9 P. M.
16th	33°	54°	43°
17th	36°	43°	35°
18th	33°	33°	28°
19th	28°	50°	38°

49. Bethlehem, N. H. 44° 20′ N. 71° 35′ W.

William Kenney, Esq. informs us that there was no storm here, the weather was mild and pleasant till the afternoon of the 18th, when there was a very little snow—the wind was very little, westwardly.

50. Portland, Maine, 43° 39′ N. 70° 20′ W. From the Diary of Lemuel Moody, Esq.

March 16th from morning to noon, light N. E. airs and clear weather. P. M. clear, calm, warm and pleasant. Thermometer at sunrise, 34° noon 46°, 8 P. M. 40°.

17th, from sunrise to noon, clear weather, with light N. E. airs. P. M. cloudy with light S. E. airs, inclining to calm.

Therm. 30° 38° 32°.

18th, forenoon brisk wind, varying from E. N. E. to N. E., with thick cloudy weather, particularly so in the south quarter. At half past one, commenced a moderate N. E. snow storm, wind not more than a brisk gale. Snow fell very moderately and ceased the first part of the evening, snow 1½ inches deep.

Therm. 30° 30° 26°

19th, forenoon moderate N. E. winds and cloudy. P. M. light winds from E, round to S. Evening clear, calm and pleasant.

Therm. 28° 45° 38°

The foregoing furnishes a summary of the information received concerning the storm, both from our regular correspondents, and in answer to the circular issued by the joint committee.

The following facts, chiefly collected from the newspapers of the day, will be found highly interesting in connexion with those already given.

From the American Sentinel, March 23.

Arrived at Philadelphia, March 23d, packet ship Algonquin, having been 11 days to the north of Cape Hatteras. On the 17th, at 8, A. M., Cape Henlopen bearing NW., distant 15 miles, took a heavy gale E. by N.; hauled off. On Sunday, the 18th, latitude 37° 50′, spoke brig Venus, for New York, who had lost two men and jib boom by gale on day previous.

From the Mercantile Advertiser of the 19th March, 40° 42′ N. 74° 1′ W.

The wind on the 17th and 18th was heavy, NE., accompanied with snow. Of course nothing got to sea from N. York, and but few vessels arrived.

From the same paper, of the 20th March.

Lewis, 38° 35′ N., 75° 12′ W. (Correspondence of Philadelphia Exchange.)

March 16th. Wind now at E., and weather very lowery.

March 17th, 2, P. M. The schooner Samuel McDowel, and shortly after the schooner Richmond, came on our beech, the wind ENE., and blowing a heavy gale.

Morning of the 18th. The Richmond has gone to pieces. From 4 till after 12, last night, the wind blew with great violence, and the sea made considerable breaks over the breakwater.

From the same paper of the 24th.

A number of outward bound vessels are detained, owing to the E. winds which have prevailed some days.

From the same paper of the 26th.

Schooner William, off Cape Hatteras, N. 35° 14′, W. 75° 30′, on the 19th, in a gale WNW., lost the deck load.

From the National Gazette of the 20th.

Cape Island, March 18th. I cannot describe to you the horrors of last night. The rain fell in torrents, and the wind, NE., blew such a gale that it baffles all description. On yesterday afternoon the wind was increasing, with rain, hail, and snow.

From the Commercial Herald and Pennsylvania Sentinel of the 20th.

Norfolk, 36° 51′ N., 76° 19′ W., 18th March. The wind continues from N. to NE. It rained nearly all day yesterday, the 17th.

From the same paper of the 22d.

Fifteen schooners at Little Egg Harbor dragged their anchors.

From the same paper of the 27th.

Arrived, ship Sabina, 50 days from Rio de Janeiro. Had been off the Capes of Delaware in thick fog from the 21st. Experienced tremendous gales from WSW. on the 17th and 18th March.

From other papers not recollected.

Schooner Caroline, in a gale on the 18th, lat. 40° 24′, long. 72° 12′, lost a man overboard.

Brig Russel, lat. 38° long. 73°, lost stern boat and davits on the 18th, during a severe NE. gale.

Packet ship North America arrived in New York on the 19th. She had to heave too from Sunday morning till Monday morning, (that is, from the 18th till the 19th) during which time it blew a gale ENE. outside the Hook.

From the Baltimore American of the 20th.

The fall of snow on the 17th and 18th, was deeper to the west than at

this place. The mail carriage, which was despatched from Frederick, west, with eight horses attached to it, was so effectually impeded by the snow, that the driver was compelled to return to Frederick. The snow on the Alleghanies, some days ago, was two feet deep along the turnpike, from Cumberland to Wheeling, and the mails were carried through with the greatest difficulty.

From the United States Gazette of the 21st.

Packet ship Pocahontas rode out the gale of Saturday night, the 17th, off the light house, on the Brandywine shoal. At one time the gale was so violent, that it was feared her masts would have to be cut away.

The same paper of the 22d states, from the Delaware Breakwater, that the gale was the most severe ever experienced at that place.

JAMES P. ESPY, *Meteorologist*.

Mechanics' Register.

LIST OF AMERICAN PATENTS WHICH ISSUED IN NOVEMBER 1837.
With Remarks and Exemplifications by the Editor.

343. For improvements in the mode of *Preparing Paint for protecting Buildings from fire;* Louis Paimboeuf, city of Washington, November 11. (See Specification.)

344. For an improvement in the *Construction of Bridges;* Francis Good, New London, Chester county, Pennsylvania, November 4.

The claim made under this patent is to "the method of uniting and binding the wood and masonry of the bridge together, by means of the vertical iron bolts passing through the sills, stone walls, wall plates, beams, iron plates, and flooring, and keyed at top, in the manner described, by which the bridge is rendered very strong, and not liable to be washed away by the sudden rising of the water; also the addition of iron plates over the beams, and over the sloped ends of the wall."

The whole plan is simply to build the vertical walls of road, or similar bridges, which are to sustain a wooden floor so that the walls shall be founded upon ground sills, through which iron bolts are to pass, standing vertically, and surrounded by the masonry; these bolts are to extend through wall plates, or cap timbers, which may be covered with iron, upon which they are to be secured by keys or nuts.

The contrivance is a very simple and obvious one, and bears a striking analogy to known devices in masonry. It has very probably been previously adopted for the same purpose, and in the same way with that set forth, but no evidence of this appearing, or being recollected, the patent was granted.

345. For a *Truss for Hernia;* Richard Salisbury, Providence Rhode Island, November 4.

There is more mechanical skill displayed in the adjustments of this truss than in most of those which have been the subject of patents, and on this its utility is dependant. As a surgical instrument, it does not possess any

novelty. The end of the spring which sustains the pad, is made square, and passes through a square hole in a piece of brass which forms a part of the adjustment of the pad, which can be slipped off, and reversed, and thus adapted to either groin. This, it is true, is of no great consequence, as the disease itself is not of a shifting character, and trusses are not left as heir looms; there, however, is nothing objectionable in this part. The said piece of brass carries a ratchet adjustment to alter the slope of the pad. as in many others. The back plate of the pad is of metal, in the centre of which there is a hole through which the stuffing of the pad may be regulated; a metal lid, or button, covers this hole. The pad swivels to the necessary distance so that it can receive an inclination to the right, or left, and be fastened by a screw. There are six claims made to individual parts, some of them of doubtful originality.

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346. For a *Machine for Shaving Shingles;* Aaron H. Akin, Sparta, Crawford County, Pennsylvania, November 4.

The shingle to be shaved is placed upon a bench by an attendant, and a knife, fixed in a sliding frame, is drawn over it by the action of a crank and pitman; there are contrivances operating as a stop to the shingle as the knife passes over it, and for relieving it at the proper time. The claim is in general terms, and the construction and operation of the machine are not very clearly described, although they might be made out by some special study.

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347. For an improved mode of constructing the *Gauges in Machines for sawing Shingles*; Akanah Leonard, Canton, Oxford county, Maine, November 4.

The gauges referred to are those for cutting the block to be sawed, and the claim made to them in their improved form is to "the mode of changing the attachment between the gauges and the sliding block at a greater or less distance from the centre of the latter, and the method of attaching them as described;" the particular arrangement for doing which would require the drawing for its explanation.

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348. For an improvement in *Stoves;* Henry H. Roath, Norwich, Connecticut, November 4.

There is some peculiarity in this stove, which is one of the vertical cylinder kind, and intended for heating only; the peculiarity consists in the manner of arranging certain tubes and chambers for the passage of heated air, and certain openings for its escape. The claims made are confined to these particular matters of construction, which do not appear to demand any special notice.

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349. For an improved *Cooking and Warming Stove;* John Morris, Derby, New Haven county, Connecticut, November 4.

This is an open stove, or rather a combination of open stoves, intended for warming parlors, or to be used for cooking. The front of the grate is in the form of a segment of a circle, about three feet long, and divided into three compartments, appearing like three open grates placed side by side. These project out from the fire place, and are covered by a flat plate extending over the whole of them. In this plate there are three

openings for cooking utensils, and others for feeding the fire. The three compartments are to be used conjointly, or separately, and the draft from them all unites in one common flue, or discharge pipe, valves being employed to govern their action. Above, and behind, the fire places, there is an oven surrounded by flues, through which the heated air may be made to pass back and forth before it reaches the chimney. Certain modifications of its respective parts are described, and a claim made to the manner of combining them, as set forth.

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350. For a *Machine for Moulding and Pressing Brick;* Henry Waterman, Bath, Lincoln county, Maine, November 4.

In this machine the clay is to be put into a mixing tub, or pug mill, in which it is acted upon by knives so beviled as to act as conveyors to force it downwards, and to cause it to pass through two openings on opposite sides of the tub, into two chambers, or boxes, the bottoms of which are formed of open divisions corresponding with brick moulds which are to be passed in below the chamber. A piston, forming the top of the chamber, is depressed by suitable machinery to force the clay into the moulds. The particular arrangement for moving the respective parts we shall not attempt to describe, but they of necessity form the subject matter of the claims, as the general construction is without novelty.

Claim. "The invention claimed by me, and which I desire to secure by Letters Patent, consists in, *first*, the method of moving the piston by means of the cams and frames as before described. *Second*, the method of moving the carriage by the arrangement of the arms attached to, and moved by one of the cams, as described. *Third*, the construction of the conveyors for conveying the clay from the mixing tub, through the apertures at the bottom thereof, into the chambers, in combination with the other parts of the machine, as described. *Fourth*, the second method of moving the piston by the crank, or hook. *Fifth*, the method of regulating the pressure of the piston by the nuts on the ends of the vertical rods."

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351. For an improvement in *Stoves, Grates, Boilers and Ovens*; Caleb Stade, city of Troy, New York, November 11.

The following claim if not distinguished by depth, is certainly not deficient in length. As we have observed on more than one occasion, but little of actual novelty is to be looked for in stoves. Perhaps when some new kind of fuel is pressed into the service, which shall differ as much from the kinds now in use, as does anthracite from bituminous coal, and from wood, we may actually see stoves differing in species from those now employed, but until then it will be best to expect varieties only, artificially produced by the crossing of breeds. But to the claim. "What I claim, is the manner of constructing the air chamber between the flanch which supports the grate and furnace, and the external plates of the stove, in combination with the air chamber next above it, in the manner, and for the purposes described. The manner of constructing the platforms, and of attaching them to the stoves, and supporting them in that combination, and detaching them from it, in combination also with the air chamber, in the manner and for the purposes described. The manner of constructing the boilers, with the manner of applying the hot air from the air chamber to, and in heating both, in combination with each other, and with the stove of the

above description. And also the double oven in combination with the same stove, and for the uses and purposes described."

Some of the things above claimed we could readily describe, but we do not wish to give the requisite time and space. Some of the others it might puzzle us to pourtray in words, and if described it might also puzzle our readers to discover their importance; we therefore forbear; a thing we are the more willing to do as fashion, which in every thing bears sovereign sway, has its capriciousness fully exemplified in stoves; the ornaments of ladies heads are scarcely more changeable. We have every winter *ne plus ultra* stoves, and the next winter we go far beyond them.

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352. For a *Machine for Cutting and Dressing Granite and other Stone;* Wm. C. Poland, and Earl Blossom, Portland, Cumberland county, Maine, November 11.

This machine, we are told, consists essentially of four parts, "1st. a gang or set, or sets, of drills, to aid in reducing the face of the stone to an even surface. 2nd. A set, for breaking the pieces left between the holes made by the drills. 3rd. A gang of cutters to do the work usually done by chisels. 4th. A gang of finishers."

The drills operate much like those used for hand drilling, in blasting rock, but their shafts are to be lifted by cams, and they are to be gauged so as to enter the stone to a given depth; provision is made to cause them to turn to a certain distance between each stroke. Rows of holes are thus to be successively made. When this is completed, the set which is to cut away the portion between the holes, is made to operate in a curved direction, something like a cooper's adze. The other instruments are afterwards made to pass over the surface thus prepared, for the purpose of finishing. The claims are to "the combination and arrangement of the drills, set, cutters, and finishers, in the manner described. The form of the set, extending quite across the face of the stone to be dressed, in combination with the other parts of the machine. The method of vibrating the drills as described."

Since the publication of the account of the successful operation of Hunter's patent stone planing machine, in Scotland, a number of similar machines have been made the subject of patents with us, but hitherto we have not received any anthentic history of their successful operation. The reason, we apprehend, is the intrinsic difficulty of causing such machines to operate well upon stone of the texture of good granite. Such stones have been actually dressed by the machines, but we apprehend that the difficulty of keeping the cutters in order has been found to be very formidable, and that it will so continue.

We have, in more than one instance, been assured that we should see the machines in use at the public buildings in Washington, but are still in waiting. We are using, as well as some granite, much miserable sand stone, which they might cut, although they would occasionally meet with a pebble that might require more humouring than would comport with the steady progress of a machine; our granite, we fear, will still bid them defiance, in which case the walls of our public buildings may continue to be built, as they have heretofore of *filtering stones.*

353. For an improvement on his *Machine for Cutting Meat;* patented February 25th, 1835. John Morris, Derby, Connecticut, November 11.

Those interested may see our notice of the original machine at page 170, vol. xvi. The improvements claimed are "the scraper, as specified. The alteration in the machine whereby the cutting is performed by a single horizontal knife, aided by the scraper; by which a multiplicity of knives are dispensed with, all clogging avoided, and the machine rendered more simple, &c."

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354. For a machine for *Separating Garlic from Grain;* Henry Staub, Sheperdstown, Jefferson county, Virginia, November 11. (See Specification.)

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355. For an improvement in the construction of *Locks for Fire Arms*; Ethan Allen, Grafton, Worcester county, Massachusetts, November 11.

The claims made are to the trigger, which is not only to discharge, but also to cock the piece ready for a new charge. To the dog or catch, which can be thrown out of action when not wanted, and leave the tumbler free to the action of the main spring; the tumbler is claimed as of an entirely new construction. The particulars of these novelties are shown in the drawings, but it is unnecessary to dwell upon them here.

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356. For improvements in the mode of constructing *Vessels to be used as Life Preservers;* John Macintosh, city of New York, November 11. (See Specification.)

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357. For improvements in the mode ot constructing *Refrigerators;* Robert D. Burns, city of Baltimore, November 11.

This refrigerator is, we are told, "with the exception of the outer case, constructed entirely of metal; zinc, on account of its economy, and its adaptedness to the purpose, being generally employed. The metallic interior is divided into any number of compartments that may be required, the partitions being all united to the main lining of the exterior box or case, by riveting, and soldering, so that the whole shall form one continuous receptacle of metal; in consequence of the conducting property of which, the cooling of one part will rapidly influence the whole." After these preliminary remarks, the specification points out what is deemed a convenient mode of forming the divisions, and the following claim is made.

"What I claim as my invention is the forming the whole interior of my cooler of metal the continuity of which is unbroken, or rendered perfect by soldering, in the manner described, so that the cooling influence operating in one compartment, may be readily communicated to the whole by the conducting power of the metal; and this I claim in conjunction with the arrangement for retaining and drawing off the water produced by the melting of the ice, as set forth."

358. For improvements in the machine for *Cutting Shingles, Staves, Heading, and other articles;* George Park, Peterboro, Madison county, New York, November 11.

A machine of this kind is too complex for verbal description. The specification extends through ten pages, and the claims refer principally to methods of effecting the different objects in view, which, though sufficiently novel to be claimed, do not offer any thing of a striking character. The claims alone would not convey any information.

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359. For a *Machine for Cutting Staves for Barrels, &c.;* Thomas Peck, Lenox, Madison county, N. York, November 20.

The remarks made on the foregoing machine apply with equal force to this.

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360. For an improved *Combination Cooking Stove;* Jordan L. Mott, city of New York, November 11.

We shall probably obtain cuts of this stove, and publish the entire specification. The points claimed are a rotary top plate, which is double, forming an air chamber between the two; the perforations for cooking utensils being surrounded by connecting rims. There is a chamber for heated air, peculiarly constructed, and claimed in combination with the above named double plate; and also in combination with a circular oven above the rotary plate, which oven, when not used for baking, encloses the boilers, and economizes the heat. There is an oven behind the fire, and a claim made to the dispensing with the bottom plate, in this and similar ovens, so as to admit the heated air directly into the oven itself.

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361. For an improved *Cooking Stove;* James N. Olney, city of New York, November 20. (For Specification, see vol. xx, p. 407.)

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362. For a machine for *Printing on both sides of a continuous sheet of Paper;* Thomas French, Ithaca, Tompkins county, N. York, November 20.

The machinery described in the specification of this patent is intended for printing on both sides of a continuous sheet of paper, as it comes from the couching cylinders of the paper mill. Stereotype plates are to be affixed upon the faces of cylinders, or rather of polygons, the paper passing from one such revolving polygon to another, being conducted and confined by tapes, whilst it is passing and receiving the impression. After being printed it is to pass to the drying cylinder, and thence to a cutting apparatus, or to a roller upon which it is to be wound. The manner of inking the plates, of giving the impression, of making register, &c., &c., we shall leave to be imagined, as the tale would be too long to be told here.

When an establishment is made, and carried into successful operation, we shall be most happy to collect and display all the details; should we live, however, we hope to accomplish much other work before being called to this, as we are apprehensive that the consummation will not be an early one. There is no novelty whatever in the idea of such an establishment; we have often conversed respecting it with an intelligent and enterprising paper maker, who made some attempts of the kind many years since, but relinquished the plan, not as impracticable, but as altogether ineligible. The

paper mill and the printing office must be together; the works printed must be such only as are wanted in vast numbers, and the rapidity of the printing must be governed entirely by that of the forming the sheet of paper. These are some of the objections which present themselves, and many others might be brought forward were it necessary.

The claim made is to "the combination and arrangement of the different parts of the before described machine for printing both sides of a continuous sheet of paper at one operation; whether effected in the manner set forth, or in any other substantially the same in principle."

This claim confines the patentee to an arrangement substantially the same with that described, in all its parts, but the specification does not point distinctly to any thing possessing this character. The thing in itself, as we have before remarked, is not new, and if any one wishes to apply a double cylinder press, for printing upon both sides of a sheet of paper, as it comes from the mill, there is no power any where to prevent him. The right, however, is scarcely likely to be legally contested.

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363. For improvements in the *Brick Press;* Henry Waterman, Bath, Lincoln county, Maine, November 20.

Those familiar with the modern devices in the brick press may form some idea of that above named, from the claim, which is as follows:

"The invention claimed by me consists in attaching the follower to the piston by loose rods (with heads,) which slide upwards through apertures in the pistons whilst the latter is in the act of pressing the brick on the top; and when said piston is again raised, the top of said piston coming into contact with the heads on the ends of said rods, and raising the follower suspended thereto, with the brick, which it thus discharges from the mould, at the same time said follower or discharger sliding loosely over the hanging arms by which the follower is suspended from the cross head for pressing the brick on the under side, in combination with the before described mode of pressing the upper and lower sides of the brick simultaneously, as set forth."

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364. For an improved *Cooking Stove;* Daniel Hastings, and Solomon Sykes, Deerfield, Franklin county, Kentucky, November 23.

The peculiarity in this stove consists in the manner of constructing those boiler holes which are immediately over the fire. These holes are surrounded by collars which rise up and receive the boilers, and within them there are loose cylinders with rims resting on the tops of the collars, and capable of being turned round, so that openings made in their sides and bottoms may coincide with openings which admit the draft from the fire to pass around boilers contained within them, or refuse a passage to such draft. The claim is to "the cylinders, both outer and inner, made and constructed as described, and placed and used in manner aforesaid."

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365. For an improvement in the mode of *Applying the Driving Wheels of Locomotive Engines;* Andrew M. Eastwick, city of Philadelphia, November 20.

"In my locomotive engine I use eight wheels, two pairs of driving, and two pairs of guide wheels; the latter not differing at all in the manner of arrangement or operation from such as have been heretofore employed. My improvement consisting entirely in the mode in which I construct an

independent frame, or truck, to receive the axles of the four driving wheels and in which I connect the same with the main frame of the locomotive."

The independent frame which carries the four driving wheels, has a projecting piece, or gudgeon, on the centre of each of its sides, which extends out, and enters slots in pedestals on either side of the main frame. The springs above the frame act upon sliding boxes in these pedestals through the intervention of bolts, in the ordinary way. The independent truck has, consequently, a vibratory motion lengthwise on the gudgeons of the frame, whilst it yields laterally by the action of the springs.

There is a contrivance described for throwing a larger portion of the weight of the engine than usual upon the driving wheels. This is effected by means of a bolt and screw nut, acting upon the engine frame, and upon the independent truck of the driving wheels, so as to draw them together, and perform a lifting action upon the guide wheels.

"What I claim as my invention and wish to secure by Letters Patent, is the employment of four driving wheels in a locomotive engine, in such a manner that these wheels shall have the bearings of their axles in an independent frame or truck, connected with the main frame of the locomotive, substantially in the way herein described. I also claim the transferring of any portion of the weight usually borne by the guide wheels, on to the driving wheels, upon the principle by me set forth."

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366. For an improvement in the *Horse Rake*; David Dewey, Pultney, Rutland county, Vermont, November 23.

The teeth of this horse rake are to be "of iron or steel, from one quarter to one half an inch in diameter, and are three feet long. They are bent at right angles one foot from their ends, forming a perpendicular of one foot, which bears upon the ground when the rake is in motion. From these angles the teeth extend two feet horizontally forward to the head of the rake, to which they are confined by nuts and screws. What I claim as my improvement in the above described machine, is the iron or steel, or other elastic rods, or teeth, as above specified."

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367. For an improvement in the *mode of constructing Double Centered Joints, Butts, or Hinges;* Egbert Hedge, Hartford, Connecticut, November 23.

These hinges resemble card table hinges, to which as well as to other purposes it is intended to apply them. The principal object of the patentee, however, is to use them as rule joints, as in this case the rule when closed has no projecting joint at its end, but all is flush with the end of the rule. As ordinarily made, however, with two joint pins, they would not open and close with truth, and to insure this they are made with cogs, or teeth, on the connecting piece and on the joint part of each of the brass straps, which for this purpose are finished off to a curve, of which the joint pin is the centre. The claim is to "the cogs or teeth in double centered joints, to insure the accurate and equal turning upon each centre, in the process of opening and closing the joint, and to keep the parts of the joint in their due positions when at rest either closed or opened."

This construction is ingenious in its application to rules, but we are apprehensive that, when its greater complexity, and liability to be out of order, are taken into the account, it will be found to be more curious than useful.

368. For an improvement in the *Reaction Water Wheel;* Nelson Johnson, Erwin Centre, Steuben county, New York, November 23.

This, so called, improvement, is at least an addition to the number of reaction water wheels on record; it does not, however, pretend to much originality, and we apprehend that its deficiency in this point will not be made up by a superabundance of utility. There is to be a bulk head into which the water is to be admitted at top, whence it is to pass through two reaction water wheels on opposite sides of it, the bulk head being perforated to receive them. The perforations are to be conical, or funnel shaped, and to these the wheels are to be adapted. The invention claimed is the "making the outer and inner rims of the reaction wheels, between which the buckets are placed, in the shape of a section of a cone."

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369. For an improved mode of *regulating the motion of the Yarn Beam in the Power Loom;* Welcome A. Potter, Cranston, Providence county, Rhode Island, November 23.

Most of the appurtenances to looms are of a nature not to be readily described in words, although they may not appear intricate when seen by those acquainted with such matters. The claim would not throw any light upon the construction of the apparatus which is the subject of the above named patent, and it is, therefore, omitted.

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370. For an improvement in the *Plough;* Bancroft Woodcock, Mount Pleasant, Westmoreland county, Pennsylvania. First patented June 14th 1837. Patent surrendered and reissued November 23.

What I claim in reference to the share is the making it with plain surfaces instead of curved ones, continuing those surfaces with a shoulder on each side, so as to leave the metal throughout so thin that when it wears off by use, the share will still present a thin edge to the ground. I claim also the reversing cutter received into a recess on the land side, and capable of having either of its edges presented forward so as to form the cutting edge of the plough, and secured in its place, on the land side by a wedge, or wedges, or in any other manner which may be preferred. I likewise claim the mode of forming the renewable point, as set forth, and the dovetailed or acute angular form given to the shank of the renewable point, for the purpose of clasping, or holding down the renewable cutter."

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371. For improved *Mills for Grinding Grain, and other articles;* Elijah S. Curtis, city of Boston, November 23.

The specification of this patent, with an engraving, is expected to be published in the next number of this Journal.

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372. For an improvement in the *Steam Boiler;* James M. Whittimore, Brighton, Middlesex county, Massachusetts, November 23.

This is a vertical cylindrical boiler, with a furnace occupying its centre, as in many other steam boilers. The water surrounds the fire, the cylinder containing it extending down to the top plate of the ash pit, which is constructed in the ordinary manner; but it is, also, to constitute a wind box, into which air is to be blown by means of a wind wheel. The vertical cylindrical boiler is surrounded by two other cylinders, the spaces between which are for a descending and ascending flue, for the heated air; they extend down to the ash pit plate, and each of them has a top, or cover,

either flat or convex, forming flues connected with those formed by the cylinders. The heated air ascends through a pipe in the centre of the furnace, extending into the inner flue space, down which it descends until it reaches near to the bottom, where there are holes admitting it to pass through into the outer space, up which it ascends, and escapes by the chimney. The claim is to the construction and combination of the flues, &c. as set forth.

We are at a loss to discover the advantage of the outward draft space in which the heated air is not in any part in contact with a surface exposed to the water of the boiler. The novelty of construction is but small, and where it exists we are unable to discover utility.

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373. For an improvement in *Wind Mills;* Jacob D. Makely, Cairo, Greene county, New York, November 23.

There is a peculiarity in this wind mill which we believe gives to it a claim to novelty; it consists in making separate foundations for the part sustaining the wings, and that containing the stones, or other machinery to be driven. The patentee says, "I do not claim the principle of placing a wind wheel and its frame upon a circular railway, nor of drawing the surface of the vanes in the wind by cords and pulleys, and regulating the same by weights. But what I do claim is the method of constructing the wind wheel with its frame and swivel placed on a circular railway on the ground, and detached from the building containing the machine or mill to be propelled; the whole combined substantially as herein described. Also the long mortise in the shaft, and the sliding belt, bar, and rod, combined with the other parts for regulating the vanes, as described."

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374. For an improvement in the machine for *Thrashing and Winnowing Grain;* Moses Davenport, Phillips, Somerset county, Maine, November 23.

The claim is to an "endless revolving elevator, with the inclined board which conveys the grain to a fan placed below the thrashing cylinder, in the manner described."

This thrashing machine does not differ from others; the elevator is an endless apron consisting of straps passing round rollers, and crossed by slats which sustain and carry off the straw, whilst the grain falls through upon an inclined board, which conducts it to a fan wheel. The novelty is very small, as will be seen by those conversant with what has been previously done, in the construction of similar machines.

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375. For a *Pistol Sabre;* Robert B. Lanton, city of New York, November 23.

This is another addition to the means of killing our fellow men with great facility. "The principal feature of the invention consists in combining a number of pistol barrels in a revolving cylinder, with a sabre in the centre, on the shank of which the cylinder revolves, between it and the handle, the barrels being caused to revolve by the movement of cocking, in a manner hereafter described."

"The invention claimed by me, and which I desire to secure by Letters Patent, consists in combining a revolving cylinder of parallel barrels, with a sabre, in the manner described, and causing it to revolve

on the shank of the latter, between the shoulder and handle; and the method of turning the cylinder of barrels, as set forth, by the movement of cocking the hammer."

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376. For an improvement in *Spring Saddles*; Harman C. Fisher, Warwick, Kent county, Rhode Island, November 25.

"What I claim as my invention, is the application to mens' and womens saddles, of spiral springs between the saddle tree and pad, as described; using for springs any metal which will produce the intended effect."

The spiral springs are to be placed between boards, &c. and are to operate in the manner of those used in sofas, carriage seats, &c.

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377. For an improvement in *Spring Saddles*; John D. Payne, Warm Springs, Bath county, Virginia, November 25.

"This improvement consists in two taper, curved, flat steel springs over the seat of the common saddle, placed side by side, and fastened by screws passing through the smaller ends into the pummel of the saddle, the wider ends resting upon the cantel, and having slats or oblong mortises in said wider ends, which move over the shanks of screws inserted into the cantel to keep said springs in their proper places."

"The invention claimed consists in the before described arrangement of curved, flat, tapered springs, extending from the pummel to the cantel of the saddle above the ordinary seat, fastened permanently by the smaller ends to the pummel, the larger ends moving freely over the cantel, said springs being covered with a padding, forming a second seat above the covered seat of the common saddle."

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378. For an improved *Mill for grinding Bark, Corn, &c.*; Charles Parker, Meriden, New Haven county, Connecticut, November 25.

This is an iron, or steel, mill, with a conical nut running in a corresponding rim. The only peculiarity in it consists in having the lower edge of the nut so formed that it shall constitute a toothed wheel, and be driven by means of a pinion upon a shaft adapted to that purpose.

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379. For an improvement in the machine for *Ginning Cotton*; F. Goodell, E. Brown, E. Tracy, and L. H. Mosely, assignees of John Stevens, Poughkeepsie, Dutchess county, New York, November 25.

This improvement is on the roller gin, for long stapled cotton. Various materials have been tried to constitute the surfaces of rollers for such gins; it being necessary that the rollers should take hold of the cotton with sufficient force to separate it from the seed, whilst it shall not adhere with such tenacity to the rollers as to be carried round by them, and in consequence become entangled. Most commonly the rollers have been made either of wood, or of metal; in the present instance one of them is made of metal, and grooved upon its surface spirally from the centre towards either end, so as to direct seed cotton along it; the other is formed of disks of cork, passed upon a suitable iron shaft, and pressed together by screw nuts so as to form a hard elastic surface, which is then to be made true and even. The claim is to "the application and manner of making the cork rollers, and the spiral grooved metallic rollers."

380. For an improvement in the *Machine for Ginning Cotton;* Lucilius H. Moseley, Poughkeepsie, Dutchess county, New York, November 25.

The design of this gin is the same with the foregoing; the only difference being in the employment of other materials to effect the same purpose with the metal and the cork in the former. Instead of the cork, disks of paper are to be pressed on to a shaft, as is done on calendering, and sometimes on paper, mill rollers. On the other rollers the surface is to be formed either of stone, or of baked clay, with a surface like biscuit, or hard unglazed earthenware. The claim is to the application of paper, stone, and burnt clay, as rollers for cotton gins.

381. For a *Horse Power;* Benjamin Hinkley, Fayette, Kennebec County, Maine, November 25.

A circular railway is to be made, about ten feet in diameter, an edge-rail of iron being affixed to its upper surface. A wheel, or platform, somewhat smaller in diameter than the iron rail, is to carry on its periphery a number of rollers, grooved to adapt them to the edge-rail, and turning upon suitable gudgeons. Over these is another circular platform, about twelve feet in diameter, upon the surface of which, near its periphery, the horse, or horses, are to be placed, there being suitable rails to keep them in place, and to which to attach them. The platform may be grooved on its edge to receive a band, by which whirls or pulleys, may be driven. The claim is to "the wheel of truck rollers, in combination with the circular revolving platform, or horse wheel."

382. For an improvement in the apparatus for *Boring the Hubs of Wheels;* James Hinds, Troy, Rensellaer county, New York, November 25.

This tool consists of a mandrel, one end of which is to be received upon a centre screwed into the latter mandrel, the other being sustained by the front centre. This mandrel may be made square, or it may be round and have a feather along it, as it is to form the slide of a tubular piece of steel, or iron, which is to fit it truly, but not to turn upon it; this tube is to be enlarged at one end, so as to be mortised out to receive a cutter, in the usual way. The wheel to be bored, is secured upon a face chuck; a dog may then be fastened on to the sliding tube, at a distance from the cutter, its projecting part bearing upon the lathe rest, when by turning the lathe, and causing the cutter to advance, the boring will be effected. If the hole is to be taper, the front centre is to be placed in a corresponding sink, or prick punch hole, out of the centre of the mandrel upon which the cutter tube slides. The claim is to a tool constructed in the manner above described.

Whether there is here enough of novelty upon which to sustain a patent is a doubtful point. Straight and taper holes have been bored by means very similar to, and producing the same effect with, that described.

383. For *Springs for Wagons, Carriages, &c.:* Porter Hill, Veteran, Chemung county, New York, November 25.

These springs are to consist of curved bars of steel, so arranged that the convex part of one of the bars shall bear upon a similar convexity

upon another. Different modes of so arranging them are presented by the patentee, but we do not think it necessary to take the time and trouble necessary to explain them. If they ever come into general use our readers will see them for themselves.

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384. For an improvement in the mode of *Weaving Hair Seating;* Charles R. Harvey, Poughkeepsie, Dutchess county, New York, November 25.

The claims made are to "the particular manner of operating and working the hook, by the transverse cam, and its connecting fixtures. Also the general arrangement of the loom, most of the parts being old, and common methods, but in this loom so combined as to produce a new result, to wit, the weaving of hair seating by a power loom." This we shall not be expected to describe.

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385. For improvements in the *Figure Power Loom;* William Crompton, Taunton, Bristol county, Massachusetts, November 25.

As respects verbal description, all looms are pretty much in the same predicament; they require to be seen, in order to their being understood. The claims in the present instance are to "the entire manner of constructing and combining the apparatus for working the jacks, as described, consisting of the lifting and depressing rods; the rods with rollers for throwing out the jacks, arranged upon a cylinder, or otherwise, the lifting rods, and the upper shaft with its connexion by gearing with the roller cylinder. Also the two notched wheels upon the upper shaft, as constructed, combined, and used, for working the pick."

SPECIFICATIONS OF AMERICAN PATENTS.

Specification of a Patent for the manufacturing of Colouring Matter, applicable to Dyeing, Staining and Writing; granted to HENRY STEPHENS, *of Great Britain, October* 23, 1837.

To all whom it may concern, be it known, that I, Henry Stephens, a subject of the Queen of Great Britain, and now residing in Charlotte street, in the Parish of St. Mary-La-Bonne, and County of Middlesex, in the said Kingdom, have invented or discovered a new and useful invention of certain improvements in manufacturing colouring matter, and rendering certain colour, or colours, more applicable to dyeing, staining and writing. And I do hereby declare, that the following is a full and exact description thereof;

My improvements in manufacturing colouring matter, and rendering certain colour or colours more applicable to dyeing, staining and writing, consists in the first place, of improvements in making or manufacturing the Ferro Prussiates (that is, Prussiates of Potash and Soda;) and secondly, in rendering Prussian Blue soluble, and thereby more applicable than heretofore to the purposes of dyeing, staining, colouring and writing, which improvements I am about to describe under different heads or sections, (that is to say,) My first improvement consists in converting certain gaseous products arising from the present mode of making Prussiate of Potash or Soda from animal matter (which are now commonly allowed to escape into the atmosphere)

to the purpose of making Prussiate of Potash or Soda, so that an increased quantity of Prussiate of Potash or Soda may be obtained from a given quantity of animal matter. For the better explanation of this part of my invention, I refer to the annexed drawings, in which Fig. 1.* represents an apparatus for effecting the process of converting the gas evolved into prussiate—*a*, is an iron pot, vessel, or retort, charged with alkali and animal, or other, matter, containing azote, or yielding ammonia, which vessel is to be heated to a low-red heat. This pot, or vessel, has a movable cover which is to be luted on when under operation, but may be removed and placed upon another pot, *b*, by disconnecting the joint in the pipe, *c*, the joint allowing the head of the pipe, *a*, to be carried round with the connecting pipe *c*. The pipe *c*, is for conducting the gaseous products arising from the decomposition of the said animal matter in the pots *a* or *b* into an iron, cylindrical, or other conveniently shaped, vessel, *d*, heated by a furnace, *h*, below. This vessel, *d*, is to be charged with alkali, and to be kept at a full red heat during the operation; *e*, is a pipe leading from the cylindrical vessel to a closed vessel, *f*, containing a solution of alkali. This vessel is furnished with a jet pipe, or burner, *g*, which is merely intended as a gauge cock, to ascertain the state of the gas within—*i*, *i*, are furnaces under the pots *a* and *b*. The gas generated in the retort, *a*, passes by the connecting pipe, *c*, to the cylinder, *d*, where meeting with the alkali in a state of fusion, the effect will be that the gas becomes combined, to a certain degree, with the alkali and forms Prussiate of Potash or Soda. But there may be portions of the said gas which do not combine, or commix, with the alkali; these will pass off by the pipe *e*, to the closed vessel, *f*, and if any of the gas thus passed off should be capable of combining with the alkaline solution, it may do so in the closed vessel, *f*, and that portion which does not combine with the alkaline solution is allowed to pass off by the gas jet-pipe, *g*; the state of operation may be ascertained by burning the jet gas from the end of this pipe, for when it ceases to burn freely, the connexion between the pot, *a*, and cylinder, *d*, should be disconnected, and the head and pipe, *c*, be removed round and luted on the pot, *b*, which is to be previously charged with animal matter and alkali, the distillation of which will proceed as before described. When the gaseous products of several charges have been passed through the cylinder *d*, containing the alkali, the cylinder may be opened and the charge (which will now consist of crude Prussiate of Potash or Soda—or "metal" as it is commonly called in the trade,) be withdrawn into an iron vessel, and when cold be lixiviated in cold water in the usual manner. The further decomposition of the charge of animal matter, in the pot, *a*, may now be conducted in the ordinary manner of making Prussiate in the open vessel by increasing the heat, the contents to be agitated as usual. This process may be repeated alternately in the two pots, *a* and *b*, the completion of the decomposition of the charge of one being effected, while that of the other is subjected to the lower heat, and the operation of distilling off its vapours and passing it to the retort, or vessel, *c*.

A similar effect, (viz.) that of taking up the gaseous products so as to produce an additional quantity of crude Prussiate of Potash, or "Metal," may be obtained in an open, conical chimney, having a false bottom, or grate, or perforated plate, upon which dry potash, or soda, is placed, so that the gas generated in the pot below may pass through the stratum of alkali in the chimney.

Fig. 2. is a sectional elevation, representing this application of my im-

* These figures are not given, as they are such as are ordinarily used by chemists.

provement: E, is the chimney, or open cone, usually placed on the top of an ordinary pot, F, for making Prussiate of Potash, in order to convey the flame upwards. G, is a grating, or perforated plate, placed at the base of the cone, E. Upon this grating, or perforated plate, G, a stratum of dry Potash, or Soda, is laid, and as the gas passes upwards through this stratum, a portion of it will become combined with the alkali. The chimney, with the stratum of the alkali, may be removed when the flame begins to burn weak, and it may be set aside and applied to future charges, or put into the pot and worked off with the charge in the usual manner of making Prussiate of Potash or Soda.

My second improvement, (viz.) the mode, method, or process, of treating, or operating upon, Prussian Blue, so as to render it more perfectly soluble, or more readily disposed to be acted upon by the subsequent process of solution, than when manufactured in the usual way, and in order that the same may be more applicable to the purposes of dyeing, staining, colouring and writing, I effect in the following manner:

I take the Prussian Blue, whether produced from a combination of Prussiate of Potash and Salts of Iron, or the Prussian Blue of commerce as commonly manufactured, and I put this into an earthen vessel and pour over it a quantity of strongly concentrated acid, sufficient to cover the Prussian Blue; Muriatic acid, Sulphuric acid, or any other acid which has a sufficient action upon iron, will do, but I prefer the Muriatic acid. If Sulphuric acid is used, it should be diluted a little, that is a quantity of water equal to about its bulk, at the time when the mass burns white after the Prussian Blue is put in. The Prussian Blue is to be allowed to remain in the acid from 24 to 48 hours, or longer. I then dilute this mixture with a large quantity of water, stirring it up at the time, for the purpose of washing from it the Salts of Iron. When in this state of dilution, I suffer it to stand until the colour has subsided, when the supernatant liquor is to be drawn off with a syphon, and more water added to it, and I continue the repetition of this process until I judge that the acid, with the iron, has been completely washed away, and this is known by testing it with Prussiate of Potash, which will show if it yields any blue precipitate; if not, it is sufficiently washed; I then place it upon a filter and suffer it to remain until the liquid has all drained away.

The Prussian Blue thus prepared is reduced to a state, as I conceive, containing less iron than the Prussian Blue of commerce, in which state it is more readily acted upon and rendered soluble, than in any other condition. This Prussian Blue may be then placed in evaporating dishes, and gently dried. To form the Prussian Blue so operated upon into a solution, I add to it Oxalic Acid, and mix them carefully together; after which I add cold water (cold distilled water is best) a little at a time, making it into a dense or dilute solution, according to the colour required. The quantity of Oxalic acid may vary according to the quantity of water used. It will be found that the Prussian Blue that has undergone this process of digestion, as described, requires but a small quantity of Oxalic acid to dissolve it. About one part of Oxalic acid will dissolve six parts of Prussian Blue, (the weight taken before digesting in the acid.) This will answer for a concentrated solution, but for a dilute solution, more acid will be required. Prussian Blue that has not undergone digestion in acid in the way above pointed out, will require a much larger proportion of Oxalic acid, from twice to three times its weight, and then it will be greatly liable to precipitation after standing; but when treated in the way described, it is not liable to precipitate, but remains a permanent solution.

The chief obstacle to the general employment of the beautiful colour obtained by means of the Ferro Prussiates to the purposes of dyeing in the silk, cotton, linen, or woollen manufactures, and also to the purposes of staining and writing, has been its hitherto supposed indissoluble nature; but by means of Oxalic acid, (whether obtained by the usual process of mixing or distilling saccharine matter in combination with nitric acid, or from vegetable, or other, substances containing Oxalic acid, or from combinations of Oxalates, whether metallic, earthy, or alkaline,) I obtain the above perfect solution of the Prussian Blue, which is applicable to dyeing, colouring, or staining, in the various manufactures of woollens, silks, linens, cotton, paper, and such other substances as are required to be dyed, or stained, and which solution is also available to the purpose of writing, or forming a writing fluid, or ink, to be used with steel, quill, or other, pens.

In conclusion, I desire it to be understood that I do not claim any of the apparatus, or machinery, described, nor the calcination of animal matters in close vessels, but I do claim the method of obtaining a product of Prussiate of Potash, or Soda, from the gases evolved from the distillation of animal matters, or any other matters that yield Azote and carburetted Hydrogen, such, for instance, as coal, by means of passing those gases into the mass of alkali in a state of ignition, and into a solution of alkali contained in separate vessels, either closely, or distantly, connected with the distillatory apparatus.

Secondly—I do not claim the use of acids for the purpose of brightening, or improving, the colour of Prussian Blue in the ordinary manner. But I do claim the use of strong acids for the purpose of digesting dry Prussian Blue of commerce, in order to render it more easily soluble in the Oxalic acid, than it would be without such a digestion. And I further claim the use of Oxalic acid, however obtained, as a solvent for Prussian Blue generally, but more especially, as a final process for making a perfect solution of the Prussian Blue which has been prepared and digested in the manner above described.

Henry Stephens.

Specification of a Patent for a Fire Proof Paint; granted to Louis Paimbœuf, *City of Washington, D. C., November* 11th, 1837.

To all whom it may concern, be it known, that I, Louis Paimbœuf, of the City of Washington, in the District of Columbia, have invented an improved mode of preparing Paint for the protection of buildings against fire; and I do hereby declare that the following is a full and exact description thereof:

My fire-proof Paint may be prepared by grinding and incorporating the ingredients used, either with oil, or with water as may be preferred. That prepared with water or other aqueous fluid, however, has one advantage over that prepared with oil; namely, it dries very rapidly, and affords the desired protection immediately; whilst that prepared with oil, will not harden until the lapse of several weeks, depending upon the season of the year.

To prepare my paint, I take the best quick lime, such as when slacked forms an impalpable powder, and slack it by the addition of so much water, only, as is requisite to produce that effect, performing this ope-

ration in a trough, or vessel, which may be covered over, so as to retain the vapour and heat as perfectly as possible, as upon this procedure I find that much of the effective strength of the composition is dependent.

When the slacking has become perfect, and the mass has cooled, I, in order to prepare my water paint, add either water or skimmed milk, or a mixture of the two, to the lime, in sufficient quantity to give to it the consistency of cream, or that of ordinary paint. When milk is not used, I add to the water a quantity of rice paste, made by boiling rice in water to a proper consistence, using about eight pounds of rice to every hundred gallons of the prepared paint. To every hundred gallons of this prepared lime mixture, I add twenty pounds of alum, fifteen pounds of potash, and one bushel of common salt. These are the essential ingredients, and the proportions such as I have found to answer well. If the paint is to be white, I find it advantageous to add to these ingredients about six pounds of prepared Plaster of Paris, and the same quantity of fine white clay. When the paint is not required to be white, I substitute clean, well-sifted, hard-wood ashes for the potash; about two bushels being sufficient for the above quantity; in this case, also, I frequently add three, or four gallons of molasses.

After mingling these ingredients, I first strain them through a fine strainer, and afterwards grind them together in a paint mill, when the paint is ready for use. When roofs are to be covered, or when crumbling brick walls are to be coated, I mix with my paint a quantity of fine white sand, in the proportion of about one pound to every ten gallons of the paint, as this addition will cause the paint to petrify, preventing leakage in roofs, and binding the crumbling particles of disintegrating brick work.

In applying this paint, excepting in very warm weather, it will be advantageous to use it as warm as it can be conveniently kept; and particular care must be taken that it be not allowed to freeze whilst drying, as its binding property would thereby be destroyed, or much impaired. Three coats will be sufficient in all cases. In putting on the first coat, the paint should be more diluted than with the others. It can be managed by any person used to the paint brush.

When the oil paint is to be prepared, I take forty gallons of good, boiled, linseed oil, and to this I add such quantity of the fine, dry-slacked lime as is requisite to bring it to a proper consistence for paint, and to this add two pounds of alum, one pound of pot, or pearl, ashes, and eight pounds of common salt. In this paint, good wood ashes may be substituted for the potash, eight, or ten pounds being used.

This paint is to be used in the same manner as other paint, taking special care that the first coat is perfectly dry before the second is applied. Under the same circumstances, the addition of a portion of white, fine sand, will produce a like good effect as in the water paint.

With these paints any of the ordinary pigments may be used, so as to obtain any colour which may be desired.

I do not claim to be the first who has applied the above-named ingredients to the purpose of rendering wood incombustible, either separately, or, to a certain extent, in combination with each other; but what I do claim as my invention, or discovery, is the combining together of lime, potash, alum and common salt, substantially in the manner herein set forth; whether the same be in the proportions herein designated, or in any other which will produce a like effect, and whether the other

ingredients named, or any similar substances, be added to the water, or the oil paint, prepared as above. LOUIS PAIMBŒUF.

Remarks by the Editor.—When the foregoing composition was first introduced in the city of Washington, it attracted considerable attention, in consequence of some public exhibitions made for the purpose of showing its efficacy, and which were, so far as they went, satisfactory. The small, wooden erections upon which these experiments were performed, had been recently, and very carefully, covered with the composition, and the question was one of much importance, how long will the protective effect continue? Will the paint, or work, stand exposure to the weather, or will it wash, or shell off? To these questions the reply of the experimenter was, that he had roofs covered with it in the West Indies, and that it was good after a lapse of five years. This assurance induced a number of persons to make essays with the material, and it was soon found that it would both shell and wash off, at an early day, and that it was, consequently, of no value whatever. Prior to this, the nature of the composition had not been made known, but an application for a patent necessarily called forth the recipe.

Those who are acquainted with the many experiments which have been instituted for the purpose of rendering timber fire proof, will not meet with any thing substantially new in the foregoing plan; all the essential ingredients, as well as many others, analagous in their properties, have been essayed, and the result made public. The propriety of granting a Patent was questioned, but it was considered as limiting the patentee to his own particular combination of ingredients, by which the public interest would not be invaded. Twenty compounds equally good, and some better, may easily be prepared, were they worth preparing. Had that in question been faithfully made, by a proper incorporation of the ingredients, and the employment of a sufficient portion of those which were known to be the most beneficial, the eventual failure would at least have been postponed, and would have been less complete.

Specification of a Patent for a Machine for separating Garlic from Grain; granted to HENRY STRAUB, *Shepherdstown, Jefferson County, Virginia, November 11th,* 1837.

To all whom it may concern, be it known, that I, Henry Straub, of Shepherdstown, in the County of Jefferson, and State of Virginia, have invented an improved Machine for separating Garlic from Wheat, or other small grain, and which will be found applicable to other purposes; and I do hereby declare that the following is a full and exact description thereof:

A cylinder is made to revolve, within a frame, by any suitable means. This cylinder, I cover over its whole periphery, with elastic teeth of wire, or with narrow elastic strips of metal, secured upon it by any suitable means. This wire, or these metallic strips, must be of such strength as will enable them to crush the heads of garlic, and reduce them into small fragments. The size of such wire, or strips, must be regulated by the material of which they are made; iron teeth, for example, will require to be stouter than those made of steel. I usually make them

about an inch long, but it may be found advantageous to vary this according to the size of the machine, and other circumstances. These teeth, of course, surround the cylinder.

A concave extends about one-fourth of the way round the cylinder; this is formed of rods, or strips of iron, of such thickness as shall be sufficient to preserve them from bending; the strips extend from side to side of the machine, and are placed so near to each other as not to allow a sound grain of wheat to pass between them; they are to have stays between them at suitable distances, to prevent their springing. I employ a feed board, down which the grain is allowed to run, and by which it is fed, in between the revolving cylinder and the concave. The edges of the strips should be square, and their angles sharp; and the teeth on the cylinder must be very nearly in contact with them.

In operating with this machine the heads of garlic, being softer than the grain, will be broken up by the action of the teeth against the concave of iron slats, between which the larger portion of the fragments will pass, and those which may fall down with the grain may be readily separated by screening.

What I do claim as my invention, and desire to secure by Letters Patent, is the separating of Garlic from Grain by passing the same between a revolving cylinder, and a concave of iron, the cylinder being covered with teeth, and the concave formed of strips, in the manner herein set forth. HENRY STRAUB.

Specifications of a Patent for an improved Apparatus, which may be used as a Life Boat, and for other purposes; granted to JOHN MACINTOSH, *City of New York, November* 11*th*, 1837.

To all whom it may concern, be it known, that I, John Macintosh, of the City of New York, have invented a new and improved Apparatus which may be used as a Life Boat for the saving of persons and property, for the conveyance of troops, baggage, and other articles, across rivers, &c., and for various other useful purposes; and I do hereby declare that the following is a full and exact description thereof:

I take canvas, or other flexible material, and render it impervious to water by means of a solution of caoutchouc, or in any other of the known ways of effecting this object; and of this flexible material, so saturated, I make my vessel, which is to contain the persons, or things, intended to be buoyed up, and conveyed upon the water. Such a vessel may be made to assume a variety of forms, dependent upon the purpose for which it is to be used, whether for one or more persons, the transportation of troops and baggage, and for other objects. The manner in which I intend, most commonly, to construct such a boat, or vessel, is the following:

I take a square piece of canvas, or other material, saturated as above stated. The edges are to be turned over, in the manner of forming a wide hem, so as to leave what, when filled with air, will become a tube, or air-chamber; the turned-over edges being securely cemented down, taking care that the juncture is air-tight. The material is then doubled over, so as to bring the opposite edges together; and the edges of the doublatures are united by cementing, or otherwise, as are also the edges

of the tubes, or air-chambers, so as to cause them to form a continuous air-tight rim, when, if the sides are separated to some distance apart, it will constitute a vessel resembling a boat. A small hose, or tube, furnished with a stop-cock, leads into the air-chamber, which may be inflated in a few moments by applying the mouth to the stop-cock. Instead of a single air-chamber, there may be two or three, one immediately under the other; when, should one be accidentally ruptured, no inconvenience would result therefrom.

It will be evident that a vessel so constructed will float in the water from the buoyancy derived from the air-chamber, and that its lower, or bag part, will also remain at the surface, or nearly so; but if persons, or any weighty articles, are placed upon this part, it will sink so as to displace a portion of water equivalent in weight to itself, if its specific gravity be not greater than that of water, and that in this way, it may be loaded, whilst the tubular part, or air-chamber, will remain at the surface, occupying the situation of the gunwale of a boat.

To form a covering to the persons, or things, contained in the vessel, pieces of air-tight canvas, or other material, may be attached round the air-chamber, and may be folded, or drawn, over the persons, or things, contained in the vessel. In some cases, it may be found desirable to leave an air-opening in the covering, which opening may be surmounted by a conical tube, or other device, for admitting air, and keeping out water.

Oars, or paddles, may be used to give a direction to such vessels; and where, for the conveyance of troops, or for any other purpose, a number of them are to cross any water, a tow-line may be carried by the first, and employed to draw the others over. For the purpose of using oars, there should be thongs, at suitable places along the edges, which, when tied together, will form loops through which the oars may pass. Other devices for propelling may be used; as, for example, a triangular, or other, float board, having a line attached to it, in the manner of a log line, may be thrown out by a person in the vessel, when by drawing the line, the vessel will be propelled, or drawn, towards the float board.

By means of thongs attached to the edges of the air-chamber, the sides of the tubular air-chamber may be made to approach each other in any part desired, and any required form be given to the outline of the vessel, by merely tying these thongs together.

Where it is desired to apply the principle to ships, steam boats, &c., the bag part need be but little larger than will suffice to contain one or two persons only, and such articles as they may desire to have with them, this may be effected by having the berth matrasses of any ship, steamboat, &c., cut into two parts lengthwise, and covered with caoutchouc, or with other water-proof flexible material, as aforesaid, to take the place of tubes, with the bag of the aforesaid material, placed between the two parts of the matrass; and in this case, it will be found convenient to attach flexible legging to the bottom of the bag to receive the legs and feet. A person may then carry the whole in his hands, walk about readily, and jump from a vessel, or wharf, into the water, and when there, may use his feet and legs to enable him to swim backwards.

With an apparatus of this kind, a covering may be used which may be drawn round the neck, over the head, or under the arms, of the person, as may be desired; and, indeed, this and other parts of the apparatus are susceptible of numerous modifications, which, as they are de-

pendent upon the judgment, or the fancy, of the person using it, it would be impossible to enumerate.

When the matrass of a vessel is used to form the gunwale of the Life Boat, such matrass may be made in two thicknesses, which, when used as a matrass, lie upon each other, but when opened out, will form the gunwale, the bag part depending from its lower edges. Or, the matrass may be cut into two parts, along its middle, so as to consist of two narrow matrasses of half the usual width, which lie side by side when in the berth, but when used as a Life Boat, then open out, the bag, as before, depending from their edges; in this case, as the two parts of the matrass are not continuous, they are to be connected by water proof ends, consisting of cloth which may be drawn up in any convenient way. This mode of using the matrass I prefer; the gunwale part being, in this case, of half the width and double the thickness of that first described, which I find to be advantageous.

What I claim as my invention, and wish to secure by Letters Patent, is the constructing an apparatus, or vessel, wholly of such flexible materials, as are herein described; one portion of which material shall constitute an air-chamber, or air-chambers, which may be readily inflated by the mouth; or made of any flexible article whose specific gravity is less than that of water; such as the materials which are commonly used in ship's berth matrasses, and filled with hair, straw, &c.; whilst the other portion thereof shall contain a bag, or receptacle, to contain persons, baggage, goods, ammunition, &c.; and this I claim, whatever be the form given to such vessel, bag, or receptacle, or to any covering which may be used therewith, whilst it is constructed so as to operate substantially in the manner, or upon the principle, herein set forth.

John Macintosh.

Progress of Practical and Theoretical Mechanics and Chemistry.

Protection of Iron by Zinc.

The invaluable discovery by M. Sorel, of an effectual and cheap method of preserving iron from rust, or corrosion, by zinc, described at page 52 of the present volume, has occasioned the formation of a Galvanized-metal company for the manufacture of zinced Iron, and the extension of its use throughout Great Britain. The happy solution of this long sought chemical problem, which will doubtless be productive of immense economy in the use of a metal, the demand for which must continually increase faster than the possibility of its adequate production, must hereafter constitute, like the steam engine, one of "the most valuable presents from philosophy to the arts." The following testimonials to the soundness of the principle and value of the discovery, are from the prospectus of the English, Scotch, and Irish Galvanized-metal Company. G.

M. Sorel, a French chemist, after many years of study and experiment, discovered an application of a scientific principle for preventing the oxydation or destruction of metals, particularly iron, as effectual as it is simple and inexpensive. His discovery is protected by a patent in France where, for some

months, the process has been in successful operation. Patents have also been granted for the invention in the United Kingdom.

The discovery has been submitted to the consideration of the following eminent British chemists:—W. T. Brande, F. R. S., Professor of Chemistry to the Royal Institution; J. G. Children, F. R. S.; Thomas Graham, Professor, London University; A. Garden, M. R. I.; Richard Phillips, F. R. S.; and such of the Reports of those gentlemen as have been received are annexed.

By Professor Graham, of the London University.

The effect of zinc in protecting iron from oxydation has been known to chemists for some time. When these two metals are in contact, an electrical or galvanic relation is established between them, by which the iron ceases to be susceptible of corrosion by dilute acids, saline solutions, or atmospheric humidity. It was found in experiments lately conducted at Dublin and Liverpool, that small pieces of zinc attached to each link of a chain cable were adequate to defend it from corrosion in sea water. The protection was observed to be complete, even in the upper portion of the iron chains by which buoys are moored, and which, from being alternately exposed to sea water and air is particularly liable to oxydation, so long as the zinc remained in contact with the iron links. The protecting influence of the zinc could not be more certainly secured than in the articles prepared by the patent process, the iron surface being uniformly coated over by that metal. In trials, to which I have had an opportunity of subjecting them, the iron escaped untouched in acid liquids, so long as a particle of the zinc covering remained undissolved. The same protection is afforded to iron in the open atmosphere by zinc, with a loss of its own substance, which is inappreciably minute. The zinc covering has the advantage over tinning, that, although it may be worn off and the iron below it partially exposed, the iron is still secured from oxydation by the galvanic action, while the smallest quantity of zinc remains upon it; whereas tin in common tin-plate, affords no protection of this kind, and not being absolutely impermeable to air and moisture, the iron under it soon begins to rust in a damp atmosphere. The simplicity and perfect efficacy, of the means employed to defend iron from the wasting influence of air and humidity in this process of zinc-tinning, certainly entitle it to be ranked as one of the most valuable economical discoveries of the present age.

Thomas Graham,
Professor of Chemistry.

University College, London, April 17th, 1838.

Jointly by J. G. Children, Esq., F. R. S., &c., and A. Garden, Esq., M. R. I., &c.

The so-called galvanized iron consists of iron coated by zinc. The process by which the union of these two metals is effected we are ignorant of, as we have not seen a copy of the French patent, but we conclude that it is somewhat similar to that by which iron is coated with tin, since, that zinc may be so employed instead of the latter metal was pointed out by the Messrs. Aikin in their Dictionary of Chemistry, as long ago as the year 1807. The method adopted by Sir H. Davy, for protecting the copper sheathing of ships by means of some metal whose electrical relations are positive with respect to the copper, may have suggested the idea of a similar protection to iron, and it is obvious to theory, and demonstrated by fact,

that zinc is an incomparably more powerful agent in producing that effect than tin. A material difference, however, exists between the French invention and that of Sir H. Davy, since the English philosopher employed *contact* of the metals only in protecting copper; whereas Monsieur Sorel avails himself of the chemical (or electrical) affinity of the metals in the most extensive and perfect contact in protecting iron.

Certain specimens have been shown to us as the results of comparative experiments made by exposing articles formed of galvanized iron, and similar articles of tinned iron, and of iron in an uncovered state, for several months, to the influence of the atmosphere, in which the iron of the first remains unaffected, whilst that of the two latter is very much oxydated. Time has not been allowed us to repeat this, the most simple and most conclusive, experiment; but those which we have been enabled to make in the short interval that has elapsed since our opinion on the merits of this invention has been demanded, give us every reason to believe that the results alluded to have been honestly obtained, and that they afford decisive evidence of the efficacy and importance of this method of protecting iron from rusting influences.

The experiments we have made consisted in exposing plates of galvanized iron, and similar plates of tinned iron, and of iron altogether unprotected, in separate vessels, to the action of distilled water, a solution of common salt of about the same strength as sea-water, and of diluted muriatic acid. In every case, the unprotected iron and the tinned iron were acted on and oxydated in a very few hours, and in three days abundance of red oxyde of iron was found to have been deposited in each vessel containing the iron plates and the tinned iron plates; but in those containing the galvanized iron not the slightest trace of red oxyde could be detected, and, except an almost imperceptible discolouration of the zinc surface, which in one or two instances had become a little darker, the galvanized iron was entirely unchanged. A piece of galvanized iron plate and of simple iron plate were also placed *in contact with each other* in distilled water, and another similar pair in a solution of common salt. In three days neither plate showed any symptoms of the iron having been oxydated, so that the protecting power of the zinc of the galvanized iron plate appears to have extended to the iron plate in external contact with it also. It had been suggested to us that perhaps accidental or partial abrasion of the zinc surface might occasion the iron to rust into holes where unprotected. We did not think this likely, nevertheless we put it to the test of experiment, and with a file cut lines into the galvanized plate entirely through the zinc, so as to leave the surface of the iron exposed, and did the same with a plate of tinned iron. In every instance the lines in the latter were filled in a day or two with red oxyde of iron, whilst those in the galvanized iron plate retained their undiminished metallic brightness. We did more,—we dissolved off every particle of zinc from two portions of the galvanized plate—in one case by very dilute muriatic acid, in the other by equally dilute sulphuric acid. As soon as the whole of the zinc was removed, the solution was poured off, and a portion of it, to which some nitric acid was previously added, was tested for iron by pure ammonia; when the only evidence that any portion of the latter metal had been dissolved was a very faint reddish tinge which prevailed through the liquid, but so slight as hardly to afford a sensible precipitate of light flocculent particles, after considerable repose. With the evidence of these facts before us, we can have no hesitation in stating our opinion that this method of protecting iron from rust will prove of infinite service in a variety

of arts, and will admit of economical application in numerous ways, as the roofing of buildings, sheathing and bolting of ships, and a thousand other forms, and entirely supersede the employment of tinned iron, except in vessels used for culinary purposes, in which, we fear, it could not safely be adopted. It is possible that the objection to the use of H. Davy's protected copper for the sheathing of ships, may also prevail against the employment of the galvanized iron for the same purpose,—the increased tendency to foulness from the adherence of barnacles, weeds, &c., to the ship's bottom; at the same time we think it probable that it may not be liable to that drawback; but this question must be referred to the only satisfactory solution—*experiment*.

J. G. Children,
A. Garden.

London, 17th April, 1838.

By William Thomas Brande, Esq., F. R. S.

Royal Mint, 26th April, 1838.

Gentlemen—I have examined the several articles sent to me by your order, under the name of *galvanized iron*, and represented as manufactured of iron in various combinations with zinc. In this way an arrangement susceptible of electric excitation is obtained, in which, consistently with the laws of electro-chemical action, a preservative power is conferred by the zinc upon the other metal; for in all cases in which two different metals are in contact, a current of electricity may be established in them in such a direction as to protect the least oxydizable of the two metals.

In common tin-plate, or tinned iron, the combination is such that the oxydizement, or corrosion, of the iron is accelerated by the tin, so that the *iron* is the *protecting* and the *tin* the *protected* metal; but in the case before us, in which the respective metals are iron and zinc, the reverse effect ensues, the *iron* is here the *protected* metal, and *zinc* the *protector;* and, consequently, when these latter combinations are subjected to the action of water and other agents, the iron is preserved from corrosion so long as any zinc remains to maintain the electrical current.

I have subjected pieces of this prepared iron to the action of distilled water, to rain water, to sea water, to the joint action of air and water, to dilute solutions of sulphuric, nitric, and muriatic acids, and to other oxydizing or corroding agents upon the common tinned plate and upon wrought and cast iron, and, as was expected, the rusting and corrosion of the iron, is in all these cases entirely prevented in the zinced, or patent, plate; whereas, on the other hand, it goes on with more or less rapidity in regard to the unprotected, and the tinned, iron; and as respects the latter, the iron, whenever it is exposed, appears to be more rapidly corroded in consequence of the adjacent tin.

As far, therefore, as under these circumstances the relative durability of the patent iron as compared with either wrought, or cast iron, or with tinned iron, is concerned, permanence is excessively in favour of the former; and there can be no doubt of the great advantage that must accrue in a vast number of the ordinary applications and uses of these substances, in the employment of the zinced, or patent, plate, and in its substitution for any of the usual forms of manufactured iron.

As my experiments have necessarily been limited in regard to time, I cannot speak with certainty as to effects which may possibly ensue from the pro-

tracted action of chemical agents upon the zinced iron; but both theory and experience lead me to believe that so long as the zinc endures, the protection will hold good.

Again, speaking theoretically, I should presume that the zinced plate, or the other forms of the protected iron, would be admirably adapted for roofing materials, gutters, water pipes, chimney tops, packing cases, and all analogous applications in which a light and durable material that will resist the joint action of air and water is required; that it would also be well adapted for certain tanks and cisterns; for the manufacture of a great variety of articles required to endure a damp atmosphere, such as locks, keys, hinges, and so forth; for cellars, warehouses, and all exposed situations; and for the iron-work of bridges, canal locks, and of much other machinery; for the beams and columns of buildings; for clamps, bars, rails, bolts, nails, screws and nuts; for all out-door works; and for many implements in, and parts of chemical and other manufactories. In short these applications are as obvious as they are endless.

On the whole, I regard this as by far the most valuable practical application of the electro-chemical principle of the protection of metals which has hitherto been carried into effect.

I am, Gentlemen,
Your faithful servant,
William Thomas Brande.

In addition to which indubitable opinions, the following translated extracts from the French Society are corroborative and interesting.

"Chemists have long attempted to apply electricity by perpetual contact to the preservation of iron; but the means employed were defective and unsuccessful, until the recent discovery by M. Sorel. Sir H. Davy died with the conviction, that the application of the principle was possible, and would some day be attained.

"Science has already given testimony in favour of M. Sorel's process. Messrs. Dulong and Dumas have frequently alluded to it in their addresses to L'Academie des Sciences.

"The following extract is from a Report made to the General Meeting of La Société d'Encouragement, at which Baron Thenard presided on the 5th July, 1837.

"'The experiments of several members of the Committee of the Chemical Arts have proved that M. Sorel's process effectually protects iron from oxydation. It is, therefore, to be expected, that the galvanic coating will soon be applied not only to the sheet-iron but to many of the larger masses of that metal, cast or wrought, which are employed in naval architecture, military implements, and domestic buildings, especially to the iron-work of shipping exposed to the atmosphere, or to salt water; to war projectiles, to masses of iron buried in damp situations, or covered with plaster.

"'The Galvanic Paint is well adapted to all articles of iron exposed to the action of air or water, or both alternately.'"

Extract from the Report of L'Academie des Sciences. Paris, 11th April, 1837.

"M. Dumas read a Report, by which it appeared that various trials had been made by Sir H. Davy and other chemists to preserve iron from rust, but that none had succeeded. He at the same time read a

letter from Captain Born, (of the Artillery of France,) addressed to the Academy, calling their attention to the vast importance of this discovery in its applicability to military purposes only. In giving the substance of Captain Born's letter, M. Dumas said, 'the military and naval artillery had a stock of 7,734,000 projectiles of the value of 26,000,000 francs (1,100,000*l.* sterling.) According to Captain Born's estimate a pile of cannon balls, after twenty years' exposure to the open air, are almost all unfit for service. If it be admitted, as it must be, that the value of a projectile, sold as cast iron, is not more than one-third of its cost price, then is the importance of this discovery apparent. Supposing that the Government of France should adopt M. Sorel's process the expense of which is very trifling, it then would appear, from Captain Born's calculations, that a saving of 17,333,334 francs, for this part alone of the war department, would accrue in twenty years.'"

The Patent Process may be applied in three different ways, all equally simple:—

1. By coating iron with zinc in a fluid state.
2. By applying a paint made from zinc.
3. By covering with a powder made from zinc.

Under the first process, many articles, not already referred to, will occur to every one considering the subject. Gas-pipes, water pipes, rails, for tram-roads, iron bridges, iron boats, roof-gutters, iron railing, interior of steam-engine boilers, iron sheathing of ships, ships' bolts, &c. On the applicability of the patent process to the three last mentioned articles but little, if any, doubt exists in the minds of our most eminent chemists. The difference in the cost of a seventy-four gun ship between iron and copper would be as 810*l.* to 6480*l.* The saving in her Majesty's Navy and in the Mercantile marine of this country would consequently be enormous.

Under the second process, zinc paint would be employed wherever the bulk of the article to be protected or the difficulty of displacing it would render an immersion of the iron into the heated metal impracticable. Bridges, therefore, already constructed, boats already built, in short all articles already fixed may be preserved from further decay by the use of the patent paint. This paint will not be dearer than white lead.

By means of the third process, the finer sorts of iron and steel will be preserved. All articles of hardware and cutlery are subject to the most serious deterioration by exposure to moisture; but by applying to them the galvanic powder, or wrapping them in paper prepared with it, they may be exposed with safety to any weather, or exported with security to any climate.

It remains only to repeat that the processes are not expensive. However numerous and important are the admitted advantages of these discoveries, they would be less striking were they to be obtained only at a high price. The process of coating with the metal in a liquid state is cheaper than tinning. Tin is worth 98s. per cwt., zinc 20s. per cwt. Supposing that galvanized sheet iron should be sold at the price of tinplate, the profit would be, at least, 100 per cent. Lond. Mech. Mag.

Blasting by Galvanism.

Mr. Bethell, who for many years past has been engaged in inquiries and experiments on diving, and is the patentee of an improved diving dress, favoured the Institution* on the following meeting, April 24, with the result of his practical experience of the effects of a blast ignited by galvanism. This he had been led to devise by having frequent occasion to blow off the decks of sunken vessels, in order to enable the divers to reach the cargo. We will first describe the usual mode of conducting this operation, which is as follows. The charge of powder is enclosed in a tin canister, and deposited in a requisite position in the wreck. It is lighted by means of a sort of quick match, made of cotton steeped in spirits of wine and gunpowder, and then dried. This match is protected from the sea water by an Indian rubber tube enclosing it, and inserted, water-tight, into the canister. These precautions being carefully taken, the fire is conveyed with tolerable certainty to the charge; but as it runs along, it, of course, blows up the India rubber tube—a very expensive process when the depth of water is considerable.

We will now proceed to describe Mr. Bethell's mode of effecting the same object: we could have wished to illustrate it by a sketch, but are unavoidably prevented by want of time. We will, however, undertake to render the matter clear to any one who has ever seen a galvanic battery in action—perhaps to some others besides. Iti s well known that a piece of platinum, or of iron wire, when made to connect two copper wires leading from the two poles of the battery, instantly becomes red hot, and capable of igniting gunpowder, or even lighting a spirit lamp. The problem for Mr. Bethell to solve, was just this; to introduce this same piece of platinum, or iron wire into his charge of powder, and keep open, when placed in its situation under water, its connexion with his galvanic apparatus in his boat above. This object he effected as follows:—To consider first his canister; in the top is fixed a cork coated with sealing wax, through which descend, water-tight, two vertical copper wires reaching into the middle of the charge. These are separate during their whole course, except at bottom, where they are connected by a piece of platinum, or of iron, wire; and at top they rise a little way above the cork, and are curled round into two distinct loops. After the charge is introduced, the top is cemented on the canister with putty. This then being all ready for the explosion, let us consider, secondly, Mr. Bethell's chain of communication. Now, here the difficulty is, that we must have not only two wires, but two wires insulated, kept totally distinct as far as their power of communicating the galvanic action is concerned; for this action is wanted in the canister, not in the boat, nor in the sea water. For this purpose Mr. Bethell coats the wires with a non-conductor; the best he considers to be the caoutchouc solution, or varnish, prepared by Macintosh and others. His wire is about as thick as common bell wire, and wrapped round with cotton thread, like the wire which the ladies use for millinery. Two of these cottoned wires are coated with the varnish; when dry they are connected together by thread, and form a galvanic rope, which may be laid by for use, in coils of any necessary length. The wires in the canister are likewise separately covered with cotton, and coated with the varnish; except at the two ends, at the one end of which

*Inst. of Civil Engineers.

they touch the platinum connecting wire, and at the other the galvanic rope leading from the boat.

And now, his apparatus being ready, Mr. Bethell proceeds to his operations. He has in his boat his galvanic apparatus, coils of rope ready prepared, and canisters ready charged. He takes out a coil; untwists the end for a short distance, removing also the cotton and varnish; he then twists the ends of the two wires, one into each of the loops projecting out of the canister top. The ends of the wires and the loops, both of which we have stated to be without varnish, are then coated separately with sealing wax—a non-conductor likewise. Thus Mr. Bethell obtains what he wants; a double chain of communication, properly insulated, from his boat to his charge of powder in the canister. He has then only to send down a diver to lodge the canister in its proper place, letting out the galvanic rope as he descends; and on the return of the man all is ready. The two wires are separated at the end of the rope in Mr. Bethell's hands; he brings one into connexion with each pole of the galvanic apparatus: the galvanic fluid finds an unbroken chain of communication down to the platinum wire in the canister: quick as thought the platinum grows red hot, and the explosion takes place as was desired.

Repeated experience has proved the efficiency of Mr. Bethell's contrivance. He has used a battery of six cells, and has found it sufficiently powerful for his purpose when using a galvanic rope of 100 yards. But so long a rope is seldom necessary in practice; for a charge of two or three pounds of blasting powder is found to produce no other effect than a wave on the surface, when exploded thirty feet under water. Mr. Bethell states, however, that one of Professor Daniel's six-cell batteries will ignite a charge at the distance of 300 or 400 yards. This would insure the safety of the operator in most cases where danger arises from the common modes of blasting; and with more powerful batteries, the effect might be produced at much greater distances—miles off, says Professor Daniel. The same method is, of course, applicable to the blasting of rocks under water, an operation frequently necessary in the construction and improvement of harbours, and in other marine works. For these purposes, also, Mr. Bethell's improved diver's dress, before alluded to, will be found of great service.

The economy of Mr. Bethell's process is very great. In all cases, the canister is, of course, blown up: by that which we have been describing, instead of an India rubber tube reaching from the boat to the charge, there is destroyed only about six inches of the galvanic rope—about a foot of common copper bell wire saves, shall we say fifty yards of India rubber tube?

Mr. Bethell's improved process is plainly capable of application to all cases where blasting is used. In military engineering, for example, it offers the grand advantage of enabling the officer himself, in safety and at a distance, to apply the match (as he would say) to a number of mines almost simultaneously, and blow up the enemy with the utmost precision. A galvanic battery indeed would at first amuse both officers and men; but as the novelty wore off, it would take its place among the paraphernalia of war, and make itself respected. It is the frequent fate of useful inventions to be first laughed at, then tried, then used—and, last of all—praised.

We confess, however, that we have always far greater pleasure in witnessing the application of new discoveries in science and ingenious inventions in the arts, to the pursuits of peace, than to the deeds of war. Man ever appears in the noblest light when employing his intellectual endowments in directing the powers of Nature rather to the preservation than the de-

struction of life. And we do hope that great good will arise from the application of Mr. Bethell's process of blasting to the purposes of mining. Lay in a mine as many blasts as you please—you may then call off all your miners and place them out of reach of danger, and explode the whole at once. The superintendent of the mine in his office, or the proprietor in his parlour, may fire all the blasts—the miner may lay the charge; but let him try to light the copper wire as long as he pleases—the platinum remains cold till the galvanic fluid darts into it and fires up the explosion at once.*

Min. Rev.

Signor Pistrucci's new method of striking up Medals without the aid of engraving. By Wm. Baddeley.

Signor Pistrucci's first application of his new process, has been in striking up a seal for the Duchy of Lancaster. This seal is four inches in diameter, of sterling silver; one side presents a very beautiful equestrian figure of her Majesty, Queen Victoria, surrounded by a bold inscription; on the reverse, the arms of the Duchy are richly emblazoned, in the midst of a profusion of scroll-work, with an inscription. To have *engraved* the two dies for striking up this seal, would have taken about fourteen or fifteen months hard labour, with the risk at the end of that time, of the dies breaking in the process of hardening. By Signor Pistrucci's method, they have been produced in less than fifteen days.

There is an exquisite softness, and a boldness of relief, in many parts of this seal not attainable in an *engraved* die; the graceful flowing of the drapery, the prominence of the arm of her Majesty, as well as the ear and hoofs of the horse, are altogether unrivalled. The fame of Signor Pistrucci's success has drawn to the Mint, most of those who are celebrated for their practical acquaintance with the powers and properties of the metals, and with mechanics generally; one and all of whom have expressed themselves astounded at the results obtained. When such gentlemen as Bramah, Maudslay and others, state, that nothing short of seeing with their own eyes would have satisfied them of the possibility of such a work, incredulity may well be pardoned in those who have not witnessed the recent production. There are plenty of workmen in the Royal Mint, well versed in all the methods employed at the *Soho* for the last fifty years, and they all agreed in designating Mr. Pistrucci's plan, when first propounded to them,—as a *new fangled and impossible scheme*, and yet have these very workmen themselves since proved its *possibility*.

The outline of Signor Pistrucci's plan, is tolerably well explained, in the *Times* newspaper; the subject is modeled in the usual way, either in wax, clay, or other fit material, from which a cast is taken in plaster of Paris. The plaster cast being hardened, is moulded in fine sand with great care, and a cast, in iron, is taken from it. The great *secret*—if there can be any secret in what has been published in the leading journal of the day, and thence very extensively copied into other publications—consists in the *thinness* of the *iron castings*. The plaster of Paris

* See Jour. Frank. Inst., vol XII, page 221, (Oct. 1833,) for a paper by Dr. Hare, in which the same mode of blasting by galvanic ignition, is suggested and described. The practical part of the operation as recommended by Mr. Bethell, is perhaps more simple and effectual—the result of frequent trial and experiment—but the principle is the same. G.

model is left only about one eighth of an inch thick, the consequence of which is, that the *chill* which takes place on the *surface* of all iron castings, from the proximity of the two surfaces in this instance, pervades the whole mass, giving it the hardness of a hardened steel die, with a toughness, not attainable by the latter metal while in a hard state.

In all large castings, the contraction of the mass of metal in cooling causes a shrinking of all the finer lines, while in thin casting, the sharpness of every line is preserved with surprising beauty.

The iron casting having been made perfectly flat at the back, a hollow is turned out in a steel bed to receive it, and when thus mounted it is ready for use. One proof among many others, of the extreme hardness of the cast iron dies, is afforded by the fact, that no extension of the metal takes place from the severest blows: the die fitting no tighter into its bed after striking up a medal, than it did before. The seal before alluded to, took upwards of one hundred and fifty blows from the most powerful press in the mint, and the dies appear in every respect as perfect now as when first cast.

Many persons, who, from their known celebrity and eminence in the scientific world, would be considered the very highest authorities that could be cited in a question of this kind, have not only on examination admitted the *entire novelty* and great importance of this process, but have charged Signor Pistrucci with injustice to himself, for neglecting to secure the privileges of a patent. This, however, the Signor has from the first declined to do; choosing rather to throw open the result of his (miscalled) "hours of idleness," for universal public benefit.

What the real value of this discovery is—or where the useful application of the fact thus established will stop, it is at present wholly impossible to imagine. The advantages of being able to produce at so little cost, and in so short a space of time, the most perfect and beautiful designs—or to copy with so much facility the choicest productions of others, are altogether incalculable. One drawback, perhaps, is the power thus placed in the hands of the fraudulent copyist, and the spurious coiner; but the knowledge of an existing power to do certain mischiefs generally produces an antidote sufficient for the evil, and it is to be hoped the present case forms no exception to the rule. One happy effect of the general introduction of this method of obtaining *dies*, will be, to make the *die-sinkers* more of *artists* and less of *mechanics*, to wield the graver *less*—but the pencil *more skilfully*. Should my endeavours to render this useful process intelligible, not be sufficiently explicit, I shall have much pleasure in affording any additional information that may be thought necessary.

Lond. Mech. Mag.

Simple Letter Copying Machine. By N. S. Heineken.

The object of this contrivance is to afford to the traveller a portable instrument for copying letters, &c. It consists simply of a brass tube 14 inches long and 1¼ diameter. One end, which has a bottom soldered into it and a cover fitted to it, contains a small bottle of copying ink. To the inside of the cover of the other end is attached a brush for the purpose of damping the paper. The space between is occupied by sheets of copying paper, together with some oiled paper and thick blotting, or filtering, paper

in a cover. To use the instrument it is only necessary to place a sheet of copying paper between the leaves of blotting paper, which have been previously wetted with the brush, and to let it remain till sufficiently damp —or, more expeditiously, to damp the copying paper itself with the brush and allow the dry blotting paper to absorb the superfluous moisture. Place the paper thus prepared upon the letter, &c., and over it a piece of oiled paper and roll the whole tightly upon the outside of the brass tube which may be then rolled under the hands upon a table; a copy may thus be readily taken off. The tube also serves the purpose of a ruler.

Lond. Mech. Mag.

Manufacture of Salt for Dairy Purposes.

The Dutch are remarkably particular as to the proper quantity and quality of their salt, of which there are three kinds manufactured. The small salt for butter, which is somewhat smaller than the common salt made in this country, is boiled, or evaporated, in 24 hours. This kind is also used, as already mentioned, in mixing in some districts with the Kanter cheese. The second salt is evaporated by a slower process, in about three days. It is used in salting by outward application, the Edam, Gouda, and in some places, the Kanter, cheeses. This kind is beautifully formed in natural crystals of about half an inch square. The third kind is larger sized; the crystals are nearly an inch square, and the evaporation process lasts four or five days. It is sometimes used for salting the cheeses by outward application, but principally for curing fish, beef, pork, &c. The Dutch pay great attention to the exact quantity of the particular kind of salt necessary, so that we never find the cheeses made in Holland salted to an intolerable degree, as we sometimes experience in this country. I (says Mr. Mitchell) endeavored to discover the mode of manufacture, and learned some particulars on this important subject, but there appeared to be some secret in the process, which the manufacturers were unwilling to disclose. One thing is certain, that the use of the Dutch salt is one of the causes of the sweet and delicious flavour of their butter, which, although always well flavored, hardly tastes of salt, or rather of that acrid quality which the poisonous bittern of the muriate and sulphate of magnesia, pervading our common salt, imparts to our butter; and this is very obvious in comparing the Dutch butter with the best salted butter of this country. When it is considered that the health and prosperity of the people are materially concerned in the use of this article in so many various ways, the propriety, or rather necessity, of improvement in its manufacture will be more evident, and it is rather remarkable that whilst chemistry has now advanced to such perfection, no change has taken place in the mode of making salt for several centuries. The late scientific Earl of Dundonald, the late Dr. Coventry, and the Rev. James Headrick, proposed important improvements in the mode of manufacturing this article, which, however, seem never to have been adopted.—*Times.*

London Mechanics' Magazine.

TRANSLATED FOR THE JOURNAL OF THE FRANKLIN INSTITUTE, BY J. GRISCOM.

Report made to the Academy of Sciences, on the Filtering Apparatus of Henry de Fonvielle. By M. Arago.

The Academy has charged M. M. Gay Lussac, Magendie. Robiquet and myself, with an examination of the filtering apparatus of M. Henri de Fonvielle. The question of filtration is so important and so keenly agitated at the present time, that high authorities, the municipal administration of our chief cities, as well as private individuals frequently consult the Academy on this subject, so that it has appeared to us to be proper to consider the problem in all its bearings. It is, besides, the best mode of suitably appreciating the new method on which we are appointed to decide.

Mankind use for drink, for cooking, for cleanliness, and for the useful arts, cistern water, well water, spring water, and river water. These four kinds of water have one common origin—rain. Rain water is, in general, so pure, that foreign matters can be detected in it, only by means of very delicate chemical reagents.

Cisterns, constructed with well chosen materials, would therefore be the best means of obtaining excellent water for drinking if the rain all fell directly into them, and did not bring with it dirt, dust, insects, accumulated in dry weather on the roofs and terraces over which it flows. In certain localities, as at Venice, for example, the inconveniences now alluded to are felt to such an extent, that they found the necessity of causing the rain water, before it reached the great cistern of the Ducal Palace, which was much resorted to by the public, to pass through a thick bed of porous materials, in the interstices of which the foreign matters held in suspension might be in part deposited.

Wells may be compared to cisterns, only they are not supplied by channels of brickwork, stone or metal. The water of the clouds reaches them, if we may so speak, drop by drop, through the common, capillary openings of the soil. It is rare that in this long and difficult trickling in fine streams, the water does not meet with soluble materials, which it dissolves in greater or less quantity. It is not therefore strictly speaking, rain water that we draw from our wells: it is generally as clear and limpid, but it contains, almost always, matters dissolved, whose chemical nature varies with the geological constitution of the country.

The same remarks are applicable to springs. The water which they distribute is also rain water, which, having passed through more or less of the crust of the earth, is returned to the surface by a siphon stream, or in other words, by pressure through streamlets of water from a more elevated situation. The nature and the proportion of foreign matters in spring water depend also on the extent of the streamlets which feed the source and the nature of the rocks through which they percolate. When these rocks are of a certain kind, the country will abound in mineral springs. If the vertical descent of the fluid is of a certain extent, the water will issue in a thermal (warm or hot) spring.

Every river bears to the sea, the waters of some principal spring, and those of a certain number of others, of minor importance, which unite with the main one in its passage. In chemical composition the water of a river might thus seem to be a medium between those of all the springs of the

surrounding country; but it must be observed, that at the time of freshets or heavy rains, (and if the valley of the river be extensive, these may occur very often) the fluvial waters do not sink into the earth in large proportions, but flow over its surface in great abundance and with great rapidity; and that in this superficial flow they can dissolve but a very small portion of foreign matter, compared with that which they will take up when divided into minute streams, and pursuing an underground course, during which the particles are so constantly in contact with soluble materials. To these considerations in favour of the purity of river water, must be added the fact that carbonate of lime is dissolved by aid of an excess of acid, and that this excess is dissipated during a long exposure of water to the air, in consequence of which the carbonate itself is precipitated.

These remarks, moreover, are to be considered only in a general point of view. It would not be difficult, in fact, without departing from the known laws of Geology, to imagine, and even to find arrangements of strata, whose wells and springs would furnish pure water, while the neighbouring rivers on the contrary, might contain a strong saline impregnation. All that we aim at is to explain how the reverse of this generally takes place,—how the water of the Seine and of the Garonne, for example, are notoriously purer than the waters of most of the springs and wells of the countries through which these rivers respectively flow.

But the advantage of greater purity in river water, chemically considered, is more than lost by their habitual want of limpidity. At each heavy rain, the little torrents are precipitated into the stream, loaded with vegetable soil, clay, gravel and all sorts of detritus which they tear up from the land, and these heterogeneous ingredients are driven along until they are gradually deposited in the river's bed.

The proportions of these foreign mixtures held in suspension during freshets, are not the same in different rivers, as might well be expected. In the Seine, this proportion rises sometimes to $\frac{1}{2000}$. He, therefore, who should drink in the course of his day's work, three quarts of the unfiltered water of the river, at the time of its highest flow, would load his stomach with more than a scruple of sand and mud. What effect, must not this, in time, produce upon his health? The question has been much discussed and it has left physicians and hydraulic engineers, very much divided in opinion. For want of exact experiments, both parties agree to leave the question where they found it. We shall certainly not be considered too severe in our judgments, if we add that one of the declared partizans of these troubled waters, rests his opinion on the alleged observation, that animals, cattle especially, do not begin to drink from the pools which they meet on the way, until they have well stirred up the mud with their feet!

But, every consideration of health aside, it is certainly very disagreeable to drink water charged with dirt. At all times and in all countries, limpidity has been regarded as a necessary quality of the water destined for human beverage; and on this account, long before the invention, or at least the perfection of the means of filtration, the ancients deemed it necessary to dig deep wells, at great expense, or to bring in by magnificent aqueducts, the water of natural springs, even when their towns were situated on ample rivers.

It is by its rapid motion through, or over, the ground, that water becomes loaded with mud. By repose, this is precipitated and the fluid resumes its natural transparency. Nothing is certainly more simple, than this mode of clarification; it is unhappily excessively slow.

From the very interesting experiments and calculations made at Bourdeaux, by M. Leupold, we learn that after 10 days of absolute repose, the water of the Garonne, taken at the time of a freshet, had not returned to its natural limpidity. At the commencement, it is true, the larger particles subside very fast, but the finer go down with a slowness which would put all patience at a stand.

Simple repose then cannot be resorted to as the means of clarifying the water destined for the supply of a large city. Who does not perceive that 8 or 10 separate basins would be necessary, each of sufficient capacity to contain all the water necessary for a day's consumption? Add to this tha in certain places and at certain seasons, water exposed in a stagnant condition to the open air during 10 consecutive days, would become foul and taste badly, either on account of the putrefaction of innumerable insects which would fall into it from the atmosphere, or in consequence of the vegetation which would begin to take place on its surface.

Repose, however, may be considered as one valuable means of getting clear of the grosser particles which are held in suspension. It is under this point of view *only*, that basins and reservoirs have been contrived and established in England and France*.

Science, or rather chance, brought to light the means of hastening considably, or rendering almost instantaneous, the precipitation of earthy matters held in suspension by water. This means consists in adding powdered alum to the turbid water. It is averred that at Paris, the gross slime brought down by the Seine, collects into long thick strings which are very promptly deposited when alum is added. The theory of this operation ought to claim the attention of chemists. It is not at present sufficiently certain, to justify us in affirming, that the same effect would take place in the sediment of every river. Some doubt seems admissible from the fact that the clarification by alum is not always complete; that certain very fine particles escape the action of this salt, remain in suspension, and render the liquid somewhat cloudy (louche) when all the stringy portions have disappeared. If it is true that water after having been alum'd, still requires filtration, we can easily conceive why the employment of alum, as a means of clarification, has not become general. Besides, in the large way, the price of the salt in addition to other means, might be objectionable. Another more serious objection is that it affects the chemical purity of river water, that it introduces a salt which it did not before contain,—that in supposing this salt wholly inactive in certain proportions, consumers might fear that at times these proportions might be very materially exceeded, and that this might easily happen through the negligence, or mistake, of a workman. One of the committee (the reporter) was speaking one day of the aluming of water to an English Engineer, whose extensive experience had given him much practical acquaintance with the habits and feelings of the public, and who was lamenting the imperfection of the means now in use for purifying water,—"what are you proposing!" said he immediately: "water, like Cesar's wife, ought to be beyond all suspicion."

This, in terms perhaps singular, but true, is a pointed condemnation, of every means of clarification which would introduce into river water any new substance, that it does not originally contain; and therefore the

*The author appears to forget that reservoirs are indispensable, as the means of insuring a regular supply when the water has to be forced to a greater height, by means of machinery, in order to bring it to the requisite hydrostatic elevation, as in the water works of Philadelphia, Wilmington, &c. TRANS.

most recent trials of engineers have all been directed to the employment of inert materials, or those which cannot add any thing to the water. These materials are gravel of different sizes,—sand of different degrees of fineness and pounded charcoal.

The idea of applying gravel and sand to the clarification of turbid waters was certainly suggested by observing so many natural springs issuing from sandy bottoms with remarkable limpidity; hence the practice is very ancient, and hence do we ascertain it to have been in vogue, in the Ducal Palace at Venice. A bed of fine sand appears to act, in the clearing of water only as a mass of sinuous capillary tubes, through which the liquid molecules may pass while the earthy matters in suspension are arrested, in consequence, simply, of their greater dimensions.

From the experiments of Lowitz, Berthollet, Saussure, Figuier, M. M. Bussy, Payen, and some other chemists, it is now known by almost every body, that charcoal has the property of absorbing the matters resulting from the putrefaction of organic bodies. The part which charcoal acts therefore in the purification of water cannot be doubtful.

Theoretically considered, the art of the clarifier, appears to be nearly complete; but this is very far from being the case with respect to its economical and successful application, especially when the object is to conduct the operations on a great scale.

Very extensive filtering apparatus has been put into operation by our neighbours on the other side of the water, and especially at Glasgow. The cost of these essays must be counted by millions (of Francs.) Nevertheless they have not been successful, but on the contrary, they have occasioned the ruin of several powerful companies.

Those who are engaged in the amelioration and extension of the useful arts, may certainly find excellent guides in natural phenomena, but on the express condition that they do not allow themselves to be seduced by imperfect similitudes. Such has been, we venture to affirm, the principal origin of the errors committed in Scotland. Certain springs, it was said, flow uniformly without interruption; they have for ages furnished the same quantity of transparent water; why should not the same result follow from an artificial fountain, under analogous circumstances. But, in the first place, is it certain that these natural springs, of which so much account is made, have experienced no diminution? where are the wooden conduits by which they have been measured? who has compared their issues, cautiously, year by year, with the quantity of rain which has fallen? Moreover, (and herein it is that the Scotch engineers have particularly erred) in an artificial fountain, the filtering strata must always be of limited extent, while the waters of a natural spring are clarified, sometimes, by beds of sand which spread over whole districts, and which act upon a fluid which is but little troubled. In the first case, the capillary tubes of the filter will soon become foul; while in the second, the effect will scarcely be visible.

The result is, that no artificial method of filtration can be successful, unless prompt, economical and certain means are at hand, of cleaning or renewing the filters. Only one of eight large companies in London, that clarify the water, viz. the Chelsea company, has attained its object. This has been done by the construction of three large basins communicating with each other; in the first two, the coarser terrene particles are deposited by repose; in the third, the water traverses a thick bed of sand and gravel whereby it becomes definitively purified. When this basin is empty, the fil-

trating mass of sand is exposed, at which time, workmen immediately remove by rakes the superficial layers which the sediment has rendered foul, and replace it by fresh sand.

A thought here suggests itself. It is not certainly, without a good reason that the able engineer of the company has made his filtering bed 6 feet thick;—the superficial layers, which the workmen remove from time to time, act without doubt more effectively than the others; but those below, must nevertheless have some influence, and must also by degrees become engorged with the matter arrested, daily become less efficient, and in time the whole must require to be changed. The necessity of this, when anticipated, would require the agency of a fourth basin, like the third, and like it of the extent of an acre of ground. The total expenditure in these works has amounted, to from 300,000 to 400,000 francs; and the manipulations of the filter, which cost annually not less than 25,000 francs, must be continually increasing.

Is it surprising, that in the view of such heavy expenses, encountered by the Chelsea Company for the filtration of 10,000 cubic metres of water per diem, corresponding to about 500 square inches of main pipe, the other English companies, should all, in an examination before parliament, declare that if compelled to filter the water of the Thames, their rental prices would have to be raised 15 per cent.

The system which Robert Thom, a civil engineer at Greenwich, introduced in 1828, has the advantage over that at Chelsea, of a self-cleaning operation, to which the whole filtering mass is subjected. This mass forms a bed 5 feet thick. The water is admitted into the basin, filled with sand, either above or below, at pleasure. If the filtration, for example, is by descension, as soon as it is perceived that the filter is obstructed and becomes effete, the water is, for a while, introduced below, and in its ascensional movement it drives the sediment from the upper surface into a discharging pipe destined to receive it.

Filtration, has not, hitherto, been attempted in France on a very large scale. In several valuable establishments in Paris, at which it is performed, a large number of small boxes, lined with lead, open at top, are provided, and contain at bottom a bed of charcoal between two layers of sand. These are, in fact, the old filters patented by Smith, Cochet, and Montfort. When the waters of the Seine and Marne, arrive at Paris, very highly charged with silt and undergo depuration in those boxes, it is found necessary to renew the strata, or at least the upper one, every day, and even twice a day.

Each superficial metre of filter gives about 3000 litres, (nearly 800 gallons) of clarified water every twenty-four hours; hence it would require 7 square metres, or 7 cubic boxes of one metre in the side, for every inch of fountain pipe, and 7000 such boxes would be requisite for the service of a town, where the consumption would demand 1000 inches.

There is a very simple method of increasing the product of these little boxes; it is to close them hermetically, and to cause the water to pass through the filtering mass, not by its own weight merely, or by a simple charge, but by strong pressure.

This, gentlemen, is one of the improvements in the filtration of water, which is proposed, and which has been realized, by the author of the memoir committed to our examination.

The filtre of Henry de Fonvielle, at the Hotel-Dieu, though it has not one metre of superficial extent, yields daily, by a pressure of 88 centimetres,

(= 34.6 inches of mercurial pressure, = $1\frac{1}{6}$ atmospheres.) 50.000 litres, (= 13,200 gallons,) at least, of clarified water. This amount, deduced from an examination of the various services of the Hospital, is a small part of what the apparatus might furnish if the feeding pump were constantly in operation. At certain times we found, in fact, by direct experiment, that the filter would yield as much as 95 litres, (= 24 gallons,) per minute. This would be nearly 137,000 litres in 24 hours, equal to about 7 inches of pipe. But the quantity first named is 17 times greater than by the methods commonly in use.

Since M. de Fonvielle presented his memoir, and especially since the results at the Hospital, several persons, and among others M. Ducommun, have claimed the invention of filtering by increased pressure. In mathematical strictness these claims might perhaps be sustained; for to a greater or less extent, it is unquestionable that in every machine existing, or known only by patent, and particularly those that filter by ascension, there is a pressure, it may be of some inches; but, regarded in a practical point of view, the question is a very different one. It is whether any one, before the author of the memoir, proposed to effect the filtration of water in vessels *hermetically closed*, allowing nothing to escape, from the pressures which the locality or the machine can produce; whether any one, prior to de Fonvielle, had arranged a filtering apparatus in such a manner that *strong* or high pressure would not derange or confuse the different layers;—whether in fact, any one before the experiments at the Hospital, had proved that a rapid filtration would give a fluid so limpid as to be perfectly satisfactory. In all these respects the rights of M. de Fonvielle appear to us to be incontestable. From the parliamentary enquiry before alluded to, we learn that engineers had not been unmindful of the possibility of effecting filtration under moderate pressure,—and that some had adopted this mode in a manner which involved them in hydraulic errors. In France we find every where, and especially at the beautiful mineral water establishment at Gros-Caillou, a fine disposable high pressure, entirely neglected. We see in fact, M. Ducommun, whose name is so honorably known in this department of the arts, using at the Hotel-Dieu, three cisterns to clarify 15 hectolitres in 24 hours, while a single one of these cisterns, modified by de Fonvielle, yields in the same time, agreeably to the report of M. Desportes, steward of the Hospital, 900 hectolitres of water, perfectly filtered, in lieu of the 15.

But the employment of high pressure is practicable only in combination with another process of which no one contests the invention with the author of the memoir.

We have seen, in time of freshets, a filter of one square metre, requiring to be cleansed once at least in 24 hours, although it would clarify only 3000 litres of water. It would seem, at the first view, that the filter of M. de Fonvielle which clears 17 times more, must require cleaning every hour. Such however, is not at all the case. No more attention is requisite than in ordinary filters.

The explanation is simple enough when we remark that under a feeble pressure, a filter acts as it were, only at its surface,—that the mud scarcely penetrates it, while, under great pressure it may, or must, sink deeper. No one will deny that if more turbid water passes in a given time, there must be a proportional deposition of feculent matter, but if this be found disseminated through a greater depth of sand, the permeability of the filter, will not be more changed by it,—the cleaning merely will be more difficult;

it is in this respect, above all others, that the new process is worthy of attention.

We have already stated that at Greenock, the engineer, R. Thom, cleans the mass of sand, by a rapid counter current, viz: from bottom to top. This mode may suffice, when the filters are choked only at the surface; but the filters of M. de Fonvielle require more powerful means. This the author finds in the action of two counter currents,—in the shock, and sudden shaking and stirring which result from them. In cleaning the hermetically closed filters of the Hotel-Dieu, the workman, whose business it is, opens suddenly, and almost simultaneously, the cocks of the tubes which connect the bottom and top of the apparatus with the elevated reservoirs, or with the body of the feeding pump. The filter is thus tumultuously agitated by two cross currents, by which it is acted upon in a manner not very unlike that which a garment undergoes in the hands of a washerwoman. These currents, have, in every case, the effect of detaching from the filtrating gravel, the foreign matters which would otherwise remain adhering to it. We have no doubt of the great utility of these conflicting currents; for after having cleaned the filter of the Hotel-Dieu, agreeably to the method of engineer Thom, i. e. by an ascending current, after assuring ourselves that this ascending current came out limpid,—as soon as the two other cocks were opened, the water rushed out from the filter in a very filthy condition.

We may add the passing remark, that the patients who witnessed the operation, expressed their great surprise at seeing, after an interval of a few seconds, the same fountain furnish, first a yellow mass as thick as soup, and then water as clear as crystal.

We may add to these numerous details, that the process which you have charged us to give an account of, has received the sanction of time. For more than 8 months it has been in operation at the Hotel-Dieu; for more than 8 months the same bed of sand, of at least a square metre in surface, has performed its functions without intermission; that there has been no occasion of renewing it; that the Seine, nevertheless, within this period has been extremely foul, and that, at the lowest estimation, 12 millions of litres of water, (12000 cubic metres,) have passed through the apparatus. From these various circumstances we have deemed it unnecessary to make any trials of the further advantages which the author of the memoir expects to derive from a division of the thick filtering body now in use, into three beds, separated from each other; and in confining ourselves exclusively to what we have sufficiently examined, we do not hesitate to say that in showing the possibility of clarifying large quantities of water with a very small apparatus, M. Henry de Fonvielle has made an important advancement in the arts.*

Progress of Civil Engineering.

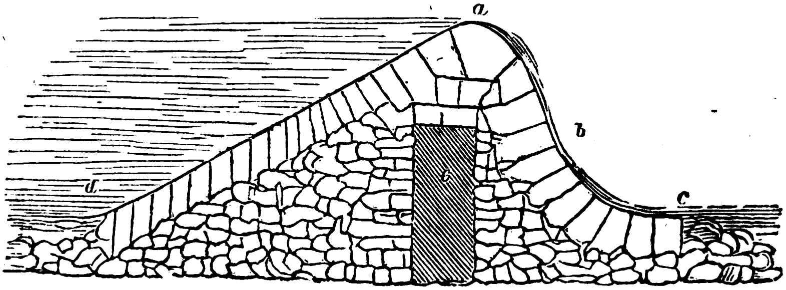
On the most proper sectional Form to be given to Weirs or River Dams.

By Robert Mallet.

The section of weirs or dams, when of masonry, appears, in most

*May we not take the liberty of suggesting the probability, that if the ascending current of water at Fair Mount, were made to pass through a tight box, containing the requisite filtering materials, agreeably to the admirable contrivance of De Fonvielle, it might furnish a simple and unexpensive mode of clarifying the water, of the river, which, at certain seasons, is so turbid as to be almost past endurance. Trans.

instances, to be pretty nearly a rule of thumb business, with the exception of some examples by Mr. Telford. The model of an earth embankment appears to have been adopted for stone ones, with but little care either as to the best position for the stones of the masonry, for maximum strength, or as to the outline that would give the easiest descent for the falling fluid, and, by consequence, the least wear and tear to the structure. Not to encumber your pages with a parade of analysis, I shall just state the results I have arrived at, and leave your mathematical readers, who will at once see what I would be at, to judge for themselves; while the practical man can discern from the figure whether the positions and forms I have assigned to the stones of the masonry are the most suitable. Supposing, then, the plan of the weir to be an arch pointing up the stream; I conceive the line of section, from *d* to *a* in the annexed figure, should either be a right line, or, pos-



sibly, a parabolic segment, presenting a convex inclined surface to the water in very deep streams. The line from *a* to *b*, I consider, should be a parabola, to which the water-level should be a tangent; because this curve gives the easiest change from direct to curvilinear motion, and hence with the least expenditure of force. Lastly, I think the line from *b* to *c* should be a cycloid, as being the curve of quickest descent; so that the combination of these two curves will fulfil the condition of giving the easiest change of motion to the water, from a rectilineal to a curved, and back again to a rectilineal, possible, and hence the minimum wear and tear to the structure; whilst they possess the co-ordinate property of a judicious form to resist the hydrostatic pressure.

I believe a weir thus formed would cause the fluid to descend in every part in an unbroken sheet, and produce little or no ripple below it. I also think the principles of the form are now for the first time stated.

Arch. Mag.

Canal parallel to the Banks of the Rhine, from Basle to Strasburg.

M. Fourneyron has communicated to the Academy the project for a railroad, with a parallel and navigable canal, from Basle to Strasburg, by Mulhouse, Colmar, &c. It has been found, that, at low water, the waters of the Rhine, in their passage from Basle to Strasburg, have a force of from 400,000 to 500,000 horse power. The project in question consists in collecting a very small part of this power, by means of a lateral canal, upon which 100 mètres, (325 ft.) of elevation will be divid-

ed into thirty falls, from Mulhouse to Strasburg. On this line a total force of 40,000 horse power will be obtained, which will produce an annual revenue of about 40,000,000 of francs. Alsace is now covered with steam engines, for which fuel is procured at about 80 or 100 leagues' distance. The expense of a steam engine is reckoned at 1200 or 1500 francs for each horse power, by the year; and it is believed that by the projected canal this same power might be produced for 200 francs per annum.

It is also proposed to form a railroad between Basle and Strasburg, upon which the wagons would be moved by hydraulic power (moteurs); for which purpose it is intended to employ another part of the strength of the waters of the river. The wagons and the diligences on this road would go at the rate of from six to eight leagues an hour.—*L' Echo*, Dec. 13, 1837, p. 207. Arch. Mag.

A Temple dedicated to the eminent men of Germany.

The king of Bavaria is going to erect an edifice dedicated to all the worthies (gloires) of Germany, on a mountain situated on the banks of the Danube, near Ratisbon. The mountain is to be divided into terraces, and on the platform, at the summit, a Grecian temple will be erected. A flight of steps 60 ft. broad will lead to the first terrace; stairs divided into two flights, will lead to a second terrace, and thence to three others. In all, there will be 300 steps, from the base of the mountain to the temple.

The edifice will be of grey marble : the exterior, decorated with pillars and pediments, will have some resemblance to the Madeleine at Paris. The pillars will be 54 in number, and of the same color as the rest of the building. Under the vestibule, will be an entrance 24 ft. high, which will have a bronze door, leading to a gallery 150 ft. long by 50 ft. broad, and nearly the same height. Projecting pilasters (des pilastres mis en saillie) will divide this apartment into three sections ; and are intended to break the uniformity. The ceiling of each section will be in the form of a tent, and will be covered with bronze, and perforated for a skylight. Above the cornice, on both sides, a row of red marble panels will contain, in letters of gold, the names of those celebrated men whose portraits have not been obtained. Fourteen giants, representing German warriors, will support the ceiling above the pillars and pilasters.

In the gallery, the busts will be arranged along the walls, on stylobates of grey marble. This gallery will be separated by pillars from a back chamber *(arriere salle)*, executed in imitation of the opisthodome of the Greek temple. A frieze 300 ft. in length will extend along the gallery, on which the most remarkable events of ancient Germany will be sculptured in Carrara marble. The two pediments will present two large historic pages : the one will represent the victory of Arminius over the Romans, and the other the *regeneration* of Germany, after the fall of Napoleon. The figure of these pediments will not be in bas relief : they will be in alto relievo (rondes basses), like the Pantheon at Athens. By this means, they will be rendered visible at a much greater distance.—*L' Echo*, Dec. 13, 1837, p. 201. Ibid.

Mechanics' Register.

Steaming Extraordinary.

Yesterday afternoon, Mr. Walter Hancock, the enterprising steam-carriage engineer, accompanied by two friends, rode from Stratford and through the principal streets of the City in a steam-gig! Mr. Hancock remained a considerable time with this novelty of science in front of Guildhall, now and then guiding it adroitly round the open space. This was about a quarter past four o'clock, when a great number of persons were present. A notice was painted on the back of the gig, stating that Mr. Hancock had no connexion with the "Steam Carriage and Wagon Company." Every one seemed surprised at the ease with which Mr. Hancock threaded his way through the crowd of carts, omnibuses, cabs, and other vehicles in Cheapside, Leaden-hall street, and other crowded thoroughfares. The gig stopped opposite the bank for a few minutes, when the machinery was inspected by Mr. Oldham, the Engineer, who has fitted up all the printing apparatus of that establishment to be worked by steam. During Mr. Hancock's temporary absence, much amusement was caused by one of the bank porters pompously ordering the gentleman left in the gig to "move on," the latter declaring that he could not. Mr. Hancock soon returned, when the machine, obedient to the guidance of its master "moved on" in fine style, and returned without accident to Stratford.

Lond. Mech. Mag.

LUNAR OCCULTATIONS FOR PHILADELPHIA, NOVEMBER 1838.					Angles reckoned to the right or westward round the circle, as seen in an inverting telescope. ☞ For direct vision add 180° ☜	
Day.	H'r.	Min.	Star's name.	Mag.	from Moon's North point.	from Moon's Vertex.
2	8	29	N. App. ☽ & 9 Tauri 6 ☽ S. 0.'9			
2	12	41	N. App. ☽ & *b* Pleiadum 4.5. ☽ S. 0.'3.			
2	12	35	Im. *d* Pleiadum,	5	113	105
2	13	53	Em.		293	327
2	13	18	Im. η Tauri,	3	121	140
2	14	34	Em.		280	327
2	14	10	Im. *f* Pleiadum,	5	83	125
2	15	19	Em.		314	8
2	14	11	Im. *h* Pleiadum,	5, 6	100	142
2	15	26	Em.		297	351
6	16	10	Im. 2 ω' Cancri,	6	106	80
6	17	23	Em.		219	245
6	16	51	Im. 4 ω^2 Cancri,	6, 7	53	48
6	18	13	Em.		264	310
13	20	5	Im. α Virginis,	1	75	52
13	21	21	Em.		203	197
21	6	2	Im. 58 ω Sagittarii	6	114	141
21	7	14	Em		293	332
21	7	46	Im. 60 *a* Sagittarii,	5, 6	65	107
21	8	27	Em.		342	28
30	14	31	N. App. ☽ χ Tauri 6 ☽ N. 2.'9.			

Anti Dry-Rot Process.

The advantage arising from the application of Kyan's process for the preservation of timber, has been so generally acknowledged, and has been so well tested by experience, that its general introduction in the mining districts, is one of the natural consequences attendant on its success. It is now some months since it was first introduced in Cornwall, where its use is becoming very general; indeed, when the expense of timbering, shafts, and other uses to which timber is applied in mines, and the heavy cost attendant on works of this nature is considered, its importance must be apparent. In railway undertakings it is also adopted; and we learn with much satisfaction, that Earl Fitzwilliam has also ordered its use in the mines possessed by his lordship. This additional evidence of the estimation in which it is held, will, we feel assured, be hailed with satisfaction by all who take an interest in scientific discoveries like the present, and which in the onset, had so much to contend with, not only from popular prejudice, but from the necessity of testing it by some years experience.

Mining Journal.

Meteorological Observations for May, 1838.

Moon.	Days	Therm. Sun rise.	Therm. 2 P.M.	Barometer. Sun rise	Barometer. 2 P.M.	Wind. Direction	Wind. Force.	Water fallen in rain.	State of the weather, and Remarks.
				Inch's	Inch's			Inches.	
☾	1	46	60	30.15	30.10	W.	Moderate.		Clear—lightly cloudy.
	2	46	50	00	29.85	S.E.	do.	.31	Rain—do.
	3	46	58	29.53	64	WN.	do.		Cloudy—flying clouds.
	4	44	49	74	70	E.	do.	.14	Cloudy—drizzle.
	5	42	53	50	35	E.	do.	1.24	Rain—do.
	6	46	60	46	46	S E. S.W.	do.	.7	Cloudy—do.—shower,
	7	45	62	67	70	W.S.W	do.		Lightly cloudy—do. do.
	8	45	52	70	70	N.W.	do		Lightly cloudy—drizzle.
☉	9	42	52	70	70	W.	do.		Cloudy—do.
	10	40	56	75	76	W.	Blustering		Clear—cloudy
	11	41	60	85	85	N.W.	Moderate.		Clear—clear.
	12	44	70	95	70	N.W.	do.		Clear—flying clouds.
	13	52	73	70	70	W.	do.		Clear—do.
	14	50	70	85	95	NE.	do.		Lightly cloudy—clear.
	15	43	73	30.06	30.10	E.S.	do.		Clear—do.
☽	16	48	78	05	05	S E.W.	do.		Fog—partially cloudy.
	17	50	77	29.70	29.70	W.	do.		Cloudy—partially cloudy.
	18	62	64	53	54	W.	do.		Cloudy—do.
	19	46	73	80	80	S.W.W.	do.		Cloudy—clear.
	20	50	80	84	80	SW.	Brisk.		Partially cloudy—clear.
	21	56	78	81	80	SW.	do.		Clear—cloudy.
	22	68	83	80	76	S.	do.	.45	Cloudy—rain
⊗	23	62	70	85	80	N.E.S.	do.	.35	Drizzle—rain.
	24	64	71	66	66	SW.	do.		Showers—flying clouds-
	25	52	55	60	50	N.W.	Moderate.		Partially cloudy—rain.
	26	42	65	60	6[illegible]	W.	do		Clear—flying clouds.
	27	46	78	64	50	S.W.	Brisk.	.15	Clear—flying clouds—showers.
	28	50	66	55	60	W.	Moderate.	.4	Clear—Shower.
	29	52	62	70	75	W.	do.		Cloudy—partially cloudy.
	30	46	68	85	88	W.	do.		Clear—do.
	31	54	82	90	90	W.	do.		Lightly cloudy—clear.
	Mean	49.03	66.06	29.75	29.74			275	

	Thermometer.	Barometer.
Maximum height during the month.	83.00 on 22d. . .	30.15 on 1st.
Minimum " " "	40.00 on 10th. . .	29.35 on 5th,
Mean	57.55 . . .	29.75

JOURNAL

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FRANKLIN INSTITUTE

OF THE

State of Pennsylvania,

AND

MECHANICS' REGISTER.

OCTOBER, 1838.

Physical Science.

FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

On the determination of Latitude by the observed difference of Zenith Distances of the Fixed Stars when on the Meridian; By E. H. Courtenay, *late Professor of Mathematics in the University of Pennsylvania.*

Of the various methods which have been proposed for the determination of terrestrial latitude, none are entirely free from objections, and nearly all those which contemplate a close approximation to the truth, require either the use of very large and costly instruments, that are transported with difficulty from place to place, or demand an expenditure of time in conducting the observations, often disproportionate to the value of the result sought.

Every method therefore which promises to increase the accuracy of such results, and to abridge the time requisite for making the observations, deserves consideration.

Under this impression, it is my purpose to explain briefly, in the present paper, some of the advantages which are believed to belong more exclusively to the method of observing the difference of meridional zenith distances of such pairs of stars as culminate at short intervals, and at nearly equal altitudes, but on different sides of the zenith. So far as I can discover, this method has not been employed in Europe: and in this country, it was first adopted in 1834, by Capt. A. Talcott of the U. S. Corps of Engineers, in settling the positions of certain points connected with the question of the disputed boundary between the State of Ohio and the then Territory of Michigan. To that gentleman I was indebted not only for the suggestion of the method—but likewise for the opportunity to test its accuracy, by the use of the instrument employed by him in the service referred to. This was kindly deposited with me during the winter of 1835–36, and when repeatedly applied to the method in question was found to afford results fully justifying the favourable opinion he had formed of it from his own observations.

Principle of the method.—If we select two stars whose places have been well determined, and so situated that one shall culminate to the North, and

the other to the South of the observer, at nearly the same distances from the zenith, and within a short interval of time—and then conceive that we are provided with any means of measuring with precision *the difference* of their zenith distances, the latitude of the place of observation may be immediately deduced therefrom. For, since the declinations of the stars are supposed known—being given by the standard catalogue—the *sum* of their zenith distances, which will be equal to the *algebraic* difference of those declinations, will likewise be known; and the *difference* of their zenith distances having been determined by direct measurement, we readily obtain the absolute zenith distance of each star by simply adding or subtracting the half difference, to, or from the half sum. The latitude is computed in the ordinary way, as though the absolute zenith distances had been observed directly.

Description of the Instrument.—The instrument employed in measuring the difference of zenith distances, was that denominated by English artists a "Zenith Telescope"—consisting of a simple achromatic, mounted on a tripod stand, which admits both vertical and horizontal motions. To the tube of the telescope, a small graduated quadrant is permanently attached, the vernier of which reads to 1′ of a degree; and the movable arm of this vernier carries a very delicate spirit level serving in connection with the quadrant to place the telescope *nearly* at any required inclination to the horizon. The quadrant being used merely to facilitate the *finding* of the objects to be observed, a very rough graduation will suffice, but the extreme delicacy of the spirit level is all important, since, when once the instrument has been clamped in a particular position, the level is relied on to show whether the inclination of the axis of the telescope undergoes any change, and if so, of what amount. The tripod stand is furnished with feet-screws, with the usual provision for quick and slow motions, by the aid of which the axis of the column supporting the telescope, is rendered truly vertical. A horizontal graduated circle, reading to minutes by means of a vernier attached to the vertical column, serves to mark the position of the telescope when it has been brought into the plane of the meridian, and likewise enables the observer to turn it promptly through 180° in azimuth. Thus, when the telescope has been once adjusted to the meridian, and directed either to the North or South, it is readily brought a second time into that, or the opposite position, as occasion may require.

To the eye-tube of the telescope, a parallel-wire Micrometer is adapted, having one fixed vertical, or two movable horizontal wires of extreme fineness. Several eye-pieces, of different powers, usually accompany such a micrometer. With the one generally employed the field of view embraced an area of about 30′. The object-glass presented a clear aperture of about $3\frac{1}{4}$ inches in diameter—but as the central parts were very decidedly superior to the exterior, I generally used the telescope with a cap which exposed only an aperture varying from $1\frac{1}{2}$ to 2 inches, according to the brilliancy of the object observed. The focal length of the telescope was about 42 inches.

Method of observation.—Let it be supposed that a suitable pair of stars has been selected, the difference of their zenith distances being less than 30′, the diameter of the field of view; and for the sake of explanation, let the northern star be supposed to culminate first, and at the greatest distance from the zenith. Having levelled the instrument, let the vernier of the quadrant be set to the degree and minute, corresponding to an arithmetical mean between the zenith distance of the two stars, and then let the bubble of the spirit level be brought to the middle of its scale, when the axis of the telescope will have the proper elevation for finding the two ob-

jects. The telescope is now turned in azimuth about the vertical axis of the column supporting it, until the optical axis coincides with the plane of the meridian (this position having been previously determined, and marked by means of the horizontal circle,) with the object glass directed towards the north. In this position we await the arrival of the northern star in the field of view, and as this is supposed to have the greatest zenith distance, it will, by the inversion of the telescope, appear above the centre of the field. The upper horizontal wire is now moved by its appropriate screw until it is brought to cover the image of the star, when, if the micrometer has been properly adjusted, the star will continue to traverse this wire until it leaves the field. But as the observation should be made at the instant the star culminates, we wait until it crosses at the vertical wire, keeping it constantly bisected by the horizontal wire. The position of the level should be examined immediately, taking care to note the divisions on its scale corresponding to each extremity of the bubble. If time permits, the position of the upper-wire of the micrometer, as indicated by the graduated head of its screw, may next be noted, and one-half the observation will have been completed. The telescope being then turned 180° in azimuth, retaining the same inclination to the horizon, the arrival of the Southern star is awaited, and the observation upon it conducted in a similar manner—with the exception that the *lower* horizontal wire is now used.

A very little practice will enable the observer to complete the observation on the first star, and prepare for that on the second in a period of four minutes—and after he has become expert in the adjustment of the instrument, a shorter time will suffice. Thus, if the interval between the transit exceeds four minutes, the stars, if at proper altitudes, will admit of being arranged in suitable pairs: and beyond this limit, the shorter the interval the better, as less time will be consumed in the observation, and we can feel more confident that the state of the atmosphere, and the condition of the instrument, have undergone no material change. When the interval is very short, the reading of the micrometer wire first used, may be deferred until after the completion of the observation on the second star.

The observations having been completed, a comparison of the readings of the two micrometer screws will give the difference of zenith distance of the two stars, which must be corrected, in all cases, by the readings of the level, if the extremities of the bubble have not marked the same divisions in both cases.

The advantages offered by this method may be enumerated as follows:

1. That it obviates almost entirely the errors likely to be introduced by an undue allowance for the effect of atmospheric refraction—for since it is only the half *difference* of the refractions which is applied as a correction to one-half the observed difference of Zenith Distances, and as the entire value of such correction will rarely exceed half a second, where the stars are advantageously situated, and do not differ more than 30′ in altitude, the *error* committed in estimating this correction must be extremely minute. It will be obvious also that simultaneous observations of the barometer and thermometer, always necessary when absolute altitudes or zenith distances are observed, may be wholly dispensed with, the effect due to the variations being quite inappreciable.

2. The only angular measurements required are made by means of a micrometer, the value of whose divisions may be rigidly tested by the observer as often as he may think proper, and with the greatest facility. The divisions of the micrometer may be read with perfect certainty to within

one half a second—a limit smaller than that which the optical power of the telescope will permit to be appreciated. Thus the errors usually arising from incorrect graduation and imperfect reading when verniers are employed, are in a great measure avoided.

3. The large dimensions of the telescope afford a high optical power, whilst the great simplicity of the other parts of the instrument permit its weight to be very moderate, thus rendering it extremely portable.

4. The observations are of so simple a character, that one person without the aid of an assistant, may readily conduct them, without incurring the risk of considerable mistakes, so likely to occur when the observer is hurried. And by selecting various pairs of stars, and repeating the observations on the same pairs, on successive nights, the observations may very soon be so far accumulated as to increase greatly the chances of accuracy.

5. By the use of various stars, the errors resulting from the erroneous determinations of their places (as given in the standard catalogues,) will probably tend to destroy each other, these errors lying sometimes in one direction—at others, in the contrary.

6. The instrument can be furnished at a moderate cost—is but little liable to injury or accident, and with reasonable care will very seldom require repair.

The only serious objections which are likely to be offered to this method of determining latitude, are—1st, the necessity of making our selections of stars from those whose places have not been settled with the greatest accuracy: and 2d, the necessity of computing the true places of the stars on the days of observation.

To the first of these objections it may be answered, that the places of a very large number of stars have now been determined with such precision, as to afford numerous pairs suitable for all northern latitudes, and almost certainly to be relied on to within 3 or 4 seconds at the utmost—in most cases, to a much smaller limit. The second objection will also be found to have less weight than would be generally attached to it, when the computor has accustomed himself to the use of the admirable table of constants given in the Catalogue of the Astronomical Society of London, in connection with the constants now furnished by the Nautical Almanac.

When a pair of stars has been selected, their places may be computed for every tenth day during two or three months, with very little more labour than would be requisite to determine them on two or three different days during that period, and as their places may vary very slowly, a simple proportion will suffice to determine them at any intermediate epoch.

It will also occasionally happen that one or more pairs of suitable stars can be selected from the catalogue of 100 stars, whose true places are now given for every tenth day in the Nautical Almanac, and the necessity of computing the effects of aberration, precession and nutation will then be entirely superseded.

There are cases also when the objection first alluded to, that of placing too great a reliance on the places of those stars whose declinations have not been determined with great precision, becomes entirely unimportant. When, for example, it is proposed to find only the *difference* of latitude between two places situated nearly on the same parallel, it will frequently occur that the same pairs of stars may be observed at both places. In such cases, the same error being introduced into each latitude by an erroneous estimate of the declinations of the stars, it will disappear when the *difference* of those latitudes only is considered; and, if in addition, the latitude

of one of the places has been very carefully determined by other means, this method of observation will furnish a simple and very accurate mode of settling the latitudes of other adjacent places.

For the purpose of presenting a simple and clear view of the degree of accuracy which may be expected with this method of observation, a table is annexed, exhibiting the results of a series of observations undertaken by myself in the winter of 1835–6, for the express purpose of testing its efficiency. The mean places of the stars, used in deducing the latitude were taken exclusively from Pond's Catalogue of 1112 stars; and their true places were computed by means of the constants in the catalogue of the Astronomical Society, whenever the same stars were likewise found in the latter catalogue. In other cases, the constants were computed directly by the usual formulæ.

It may be proper to remark that the results here given have not been selected with any reference to their more exact agreement with each other; but on the contrary, they present a perfectly fair view of what may be anticipated from this method of observation, as soon as the observer has acquired a moderate share of skill in the use of the Instrument. Indeed the only observations which have been excluded, were those in which it was found, upon trial, to be impossible to make the observations satisfactorily, in consequence of the stars being very near the extremities of the field of view. This would, of course, happen only when the difference of their zenith distances, was nearly 30′.

In making these observations, the instrument was placed on a stand in the yard of my house in Philadelphia at the S. E. corner of Spruce and Broad streets, the centre of the stand being 90 feet from the front on Spruce, and $5\frac{1}{2}$ from that on Broad street: and as nearly as I can estimate from the plan of the City about 7.″ 93 South of the steeple of Independence Hall. The latitude of that building as given in the American Almanac, is 39.° 56′ 59.″ 00

From which subtracting 7.″ 93 — 7.″ 93

Leaves the latitude of the spot occupied by the instrument, 39.° 56′ 51.″ 07

And the general mean of my observations shewn in the annexed abstracts, 39° 56′ 50.″ 60

Difference, 0.″ 47

I am unable to state in what manner the result given in the Almanac was obtained, and cannot judge therefore of the degree of reliance to be placed on it. Most probably it has been determined with considerable care—and if so, the close agreement of the two results is a strong evidence in favor of their accuracy.

Abstract of Results furnished by a Series of Observations for Latitude of the difference of Zenith Distances of N. and S. Stars; the Instrument employed being a Zenith Telescope, furnished with a Level and Micrometer.

Date.	Pairs of Stars.	Latitude.
1835.		
Nov. 20	υ Pagasi & 2807 Cassiopia	39° 56′ 48″.83
25	" "	47″.37
Dec 1	" "	50″.56
3	" "	49″.32
8	" "	48″.18
22	" "	50″.55
23	" "	49″.80
Nov. 20	υ Pegasi & τ Cassiopia	47″.84
25	" "	48″.11
Dec 1	" "	49″.52
8	" "	47″.26
22	" "	50″.57
23	" "	49″.26
Nov. 21	ο Piscium & 209 Cassiopia	51″.26
25	" "	50″.76
26	" "	51″.12
28	" "	49″.78
Dec. 23	" "	51″.04
Nov. 25	δ Cephei & λ Pegasi	49″.52
Dec. 1	" "	51″.94
3	" "	50″.39
23	" "	51″.11
23	ξ 2 Arietis & ν Custa Mess	51″.44
Nov. 25	ζ Cephei & λ Pegasi,	46″.36
Dec. 3	" "	48″.46
Nov. 21	209 Cassiopia & ξ′ Ceti	52″.13
25	" "	52″.19
26	" "	51″.18
28	" "	51″.99
Dec. 23	" "	50″.87
1836. Jan. 23	" "	51″.31
1835. Dec. 23	287 Arietis & γ Persei	51″.78
1836. Jan. 23	" "	51″.68
1835. Dec. 23	304 Arietis & γ Persei	53″.58
1836. Jan. 23	" "	53″.87
1835. Dec. 23	ξ Arietis & 371 Camelop.	54″.99
1836. Jan. 23	" "	53″.39

Date.	Pairs of Stars.	Latitude.
1836.		
Jan. 23	π Tauri & 552 Camelop.	39° 56′ 50″.18
Feb. 10	" "	48″.11
10	834 Camelop. & 840 Monoc.	52″.67
M'ch 23	" "	50″.49
April 6	ο Ursæ Maj. & θ Cancri	53″.00
6	1148 Ursæ Maj. & π Leonis	50″.13
Feb. 10	765 Camelop. & γ Geminor.	48″.67
10	764 Camelop. & χ Orionis	46″.59
10	764 Camelop. & γ Geminor	48″.50
10	764 Camelop. & χ 3 Orionis	48″.83
10	715 Camelop. & χ 3 Orionis	49″.00
10	715 Camelop. & χ 1 Orionis	46″.75
Jan. 23	552 Camelop. & c′ Orionis	53″.67
May 12	ο 2 Camelop. & θ Virginis	51″.27
13	" "	54″.30
12	o′ Camelop. & θ Virginis	49″.36
13	" "	52″.63
8	λ Draconis & ο Virginis	51″.44
10	" "	51″.89
12	" "	51″.20
8	θ Virginis & k Draconis	49″.90
9	" "	51″.85
10	" "	51″.66
12	" "	50″.45
13	" "	51″.62
May 6	ξ′ Virginis & k Draconis	47″.84
8	" "	50″.59
12	" "	50″.90
Ap'l 24	λ Draconis & ξ′ Virginis	51″.32
May 5	" "	52″.28
8	" "	51″.90
12	" "	51″.76
Ap'l 24	ρ Leonis & 126 Ursæ Maj.	51″.05
May 8	" "	50″.41
9	" "	50″.58
10	" "	50″.53
12	" "	51″.44

TABLE CONTINUED.

General mean,	39° 56′ 50″.60	Mean of the 26 observations in April and May,	39° 56′ 51″.20
Greatest variation from mean,	4 39	Greatest variation from mean,	3. 36
3 variations exceeding	4	2 variations exceeding	3
6 betwen	3 & 4	0 between	2 & 3
10 between	2 & 3	6 "	1 & 2
23 between	1 & 2	18 below	1
32 below	1	Mean variation of the 26 observations.	0. 89
Mean variation of the entire series of 74 observations.	1. 39		

If the places of the several stars observed were given with absolute accuracy, it would be proper to take a general mean of all the *independent* results, thus assigning an equal weight to each observation—and for the sake of simplicity this has been done—although, strictly speaking, the places of certain stars having been determined by a large, others by a very small number of observations, the positions of the former are to be relied on with greater confidence than those of the latter. It may also be observed that the results given in the preceding table, are not *all* perfectly independent. For in some instances it was found possible to combine more than two stars; when, for example, one northern star having nearly the same zenith distance as two southern stars, could be observed without a change in the inclination of the telescope, two different results would be given by *three* observations, whereas *four* would usually be required. It has been deemed sufficient, however, for the present purpose to compare the separate results with an indiscriminate mean, a slight variation in which would have but little influence on such comparison. By subtracting each result separately from the general mean, it will appear that the extreme variation from the mean is but 4″.39, and that the average variation from the same quantity in the entire series of 74 observations is 1″.39. An examination of the table will also exhibit very satisfactorily the rapid diminution in the number of errors as the limits of error are increased, there being but 3 errors exceeding 4″—8 between 3″ and 4″—10 between 2″ and 3″—23 between 1″ and and 2″ and 32 below 1″.

It was reasonable to expect that the observations latest in point of date would present results yet more nearly accordant with each other, than those afforded by the entire series, as some time was requisite to acquire the habit of using the instrument in a manner entirely satisfactory. Accordingly, a comparison was made of the 26 observations latest in point of date—the results of which are given in the table. In this series the average variation from the general mean is reduced to 0″.89; the greatest variation to 3″.36, and 24 out of the 26 errors are below 2″.

Undoubtedly very many of the larger discrepancies are to be ascribed to erroneous assumptions of the places of the stars—not to the errors of observation. This will appear very clearly by comparing the different results given by the same pair of stars on different nights. The greatest difference between any two results thus obtained, will be found to be 3″.27.; whereas the extreme difference between the greatest and least in the entire series is more than double the quantity.

Whilst insisting earnestly upon the advantages of the method of observation above described; it is not pretended that each of these advantages may not be secured separately by other methods; but it is doubted whether any other combines in so great a degree the recommendation of convenience, accuracy and despatch.

FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

Remarks relating to the Storm of March 17th, 1838. By James P. Espy.

PART I.—CONDENSED STATEMENT OF THE FACTS.

It appears from the facts detailed in the report of the committee on Meteorology*, that a storm of rain and snow of great violence was raging on the 17th of March, reaching N.E. and S.W. from the Western extremity of N. Carolina to the N.E. extremity of Pennsylvania—and in a N.W. and S.E. direction, from about the middle of Ohio, to the Eastern extremity of N. Carolina, and East and West from beyond Lexington, Kentucky, to some distance into the Atlantic beyond the Eastern shore of Maryland. The storm was much the greatest on the 17th, and its boundaries on this day about noon, have been represented by the middle circle in the map accompanying the report of the committee. This storm moved along the surface of the earth nearly towards the East.

It appears that the Barometer fell on the 17th in all places near the centre or far within the boundaries of the storm—and rose in many places near its borders, and beyond them; especially in the extreme W. and NE. (see Lexington, and Montreal, and Providence, and Middletown.)

It appears also—what might naturally be expected from the fall of the Barometer within the storm—that the wind at the borders and for some distance beyond, blew inwards, towards the storm. The information which we have at present does not enable us to know whether the Barometer stood lowest in the very middle of the storm or not. If it did—and there were no general currents in the atmosphere to produce oblique forces, the laws of dynamics justify us in expecting the wind in such case to blow *inwards* from the circumference, exactly towards the centre, just as we would expect the wind to blow outwards *from* the centre of a storm—if there was any cause in nature to make the Barometer stand constantly higher at that point than in the circumference.

By casting the eye on the map accompanying the report, it will be seen that there is no one point at which all the arrows, if prolonged, would meet. There is indeed much irregularity in this respect. For example the arrow near Jamestown, N. Carolina, which is south of the centre of the storm, still shows the wind N.E.; as if the point of greatest depression of the Barometer, was near the southern border of the storm; somewhere in N. Carolina: while in the Northern part of the storm, the arrow for Silver Lake, shews the wind to be N.W.; as if the point of greatest depression of the Barometer was near the North part of the storm.

And yet, if the strong winds be considered in the extreme boundaries of the storm, for example, Springfield and Wilmington, in Ohio, and in the east (all the observations from the Chesapeake to New York,) these arrows being prolonged will meet very little south of the centre of the storm; and, as the winds were all strong and steady, for many hours, and were under the *general* influence of the whole storm, and not affected by any *particular* localities, they speak a language which cannot be mistaken.

The wind could not blow thus strongly inwards for many hours without moving upward in the centre of convergeance: whether that was the centre of the storm or not, and as the barometer continued to fall in the region of the storm during the whole day, the air must have flowed outwards from the region of the storm *above* even faster at first than it flowed in-

*See this Journal for last month.

wards *below*, otherwise the barometer would not have fallen within the storm.

The storm was so nearly round on the 16th and 17th, that it would be an affectation of accuracy beyond our data, to give any other figure in the topographical chart. It was also so nearly the same size on each of those days that it is impossible to say on which day it covered the largest territory, the quantity of rain and snow known on the 16th, was small, while that on the 17th was very great. But on the 18th, it greatly increased its size, (*if it remained round*,) for on that day its diameter from S.W. to N.E. along our coast was more than 600 miles, reaching from N. Carolina, to Maine. Whereas on the two preceding days it was only about 500 in diameter.

From the 16th to the 17th, the storm travelled towards the East or even a little South of East: for on the 16th there was considerable snow in the Southern part of Michigan, and on the night of the 16th, and on the 17th, there was very little snow at Meadville, Pennsylvania; though Meadville is on a lower latitude. But on the 18th the storm manifestly moved towards a point North of East, for, at half past one P. M., it began to snow in Portland, Maine, 2 degrees further North, than it extended while in Pennsylvania.

Whether this extension of the storm further North, depended on the direction in which its centre was moving, or on a general widening out of the storm, cannot be determined; as its southern boundaries on that day are not strictly defined by the facts collected. It certainly extended down to Lat. 38° in Long. 73°, wind still N.E. And there were strong gales W.S.W., about that time. from Lat 31° to Lat. 34°. Though the packet ship Algonquin, in Lat 37° 50′ (Long. and time of day not given) says nothing of the storm of that day—but speaks of the one on the day before, it would be extremely desirable to know what her log-book says of the storm after she took the gale E.b.N. near the Delaware Capes, at 8 A. M. of the 17th, and then hauled off. As she went to the South—her log would probably be able to answer a very interesting question which our present information leaves undetermined. *In what direction and with what force did the wind blow on the South East side of the storm on the 17th.**

This storm travelled with a velocity of about $18\frac{1}{8}$ miles an hour from beginning to beginning. It was just one day in reaching Philadelphia, after it commenced in Springfield, Ohio; a distance of about 435 miles, and a comparison with other points agrees well with this.

There is one *apparent* anomaly worthy of particular notice. On the N.N.E. of the storm 80 or 100 miles beyond its extreme boundary, there is a region, from which the wind seems to have blown outwards in all directions.

Albany seems to be included in this region—and if it shall be found, that at Albany and the town near it, or perhaps as far West as Utica, the barometer rose considerably on the morning of the 17th, one step will be made in the explanation of this phenomenon, whatever may be the cause of this rise.

But the two most remarkable irregularities of all will be found at Meadville, Pennsylvania, and Lexington, Kentucky.

*Any further information concerning this storm will be gladly received. If every person keeping a journal of the weather within and for some distance beyond its boundary would send a copy of it for the 15th, 16th, 17th, and 18th March, the apparent irregularities of this storm would probably be explained.

Here the wind seemed to blow almost in a tangent to the storm. There is an irregularity somewhat similar to this on the South East side of the storm at New Garden, N.C. where the wind was N. E. all day, probably not strong, as the force is not mentioned. In short, by casting the eye on the chart it will appear, by directing the attention to the N.W. side of the storm, that the wind had a tendency to rotate from right to left; and again, if the attention be directed to the S.E. side of the storm, it will appear that the wind had a tendency to rotate from left to right—which precludes the idea of a general rotation the same way—and shews that there was some cause which induced the wind at the extreme N.W. and S.E. and E. to move towards a point in the storm, south of its centre. These anomalies cannot be explained fully by the facts collected without the aid of hypothesis, and I do not permit myself to *hypothesise.* We have no barometrical observations South of Washington; yet from the immense quantity of rain and snow which fell in the Northwest corner of N. Carolina, it is not improbable that a much greater quantity fell in the Southern part of the storm than in the Northern.

Besides, as the barometer fell much more at Washington city than at Philadelphia, and places further North, it may be that it fell still more further South and West. But I forbear to conjecture.

Part II.—Rationale.

It will not be esteemed by the reader impertinent in me to offer my views as to the modus operandi of nature in producing the various phenomena accompanying the storm of the 17th March, as detailed in the "Report" of the Meteorological Committee, and summed up in the preceding "Remarks."

The upward motion of the air in the region of a storm, may take its commencement either from a higher temperature, or a higher dew-point.

As the air rises in the inner portions of the storm, it is reduced in temperature by diminished pressure, a little more than one degree for every hundred yards of its ascent, as I have ascertained by experiment; and when it has ascended as many hundred yards as the temperature of the air is above the dew-point, the vapour will begin to condense into cloud, and give out its caloric of elasticity—this caloric of elasticity is received by the air in contact with the condensing vapour, and prevents the air in its further ascent from cooling as fast as it would, if there was no vapour in the air to condense; and, I find, both by calculation and experiment, that in ordinary states of the dew-point, it cools only one-half degree each hundred yard of its ascent above the base or lower part of the cloud; and that in all states of the dew-point, the air in the cloud at the moment of its formation, is expanded about 5600 cubic feet for every cubic foot of water generated by the condensed vapour, after making allowance for the condensation of the vapour itself.

This great expansion of the air in the cloud will cause a rapid ascent and out-spreading above, which will cause the barometer to fall under the cloud, and if there was no current above, it would spread out on all sides equally in an *annulus*, and cause the barometer to rise all round the storm, as much on one side as another. But as there is known to be an upper current always, or almost always, moving in this latitude towards the N.E. or E.N.E., this current will cause the out-spreading of the air to be chiefly in that direction, and consequently the barometer will rise chiefly on that side of the storm, at the very time it is falling within the storm, as it actually did in Connecticut and Rhode Island, while it was falling in Annapolis and

Washington City. Now if it should be found that the rise extended to Albany and Utica, the explanation of that remarkable phenomenon mentioned before, of the winds blowing outwards in all directions from that region, it will be acknowledged that this is the true explanation of it.

If it should be found that the barometer did not rise at these places, some other facts may yet be discovered to explain the anomaly.

On the very great irregularities presented at Meadville and Lexington, I have nothing entirely satisfactory to say. In a storm of such great magnitude, many irregularities might be expected.

I have been told by those who have witnessed the phenomenon, from very lofty mountains, when it is raining in the valley below them, that the top of the cloud, which they could see spread out before them, did not exhibit a level plain, but many pyramidal elevations were to be seen rising considerably above the ordinary level. Now this seemed to indicate a more violent action under those elevations than in the other parts—and if we conceive the action very great, as it is in all summer hail storms, in which the drops of water are carried up to a great height and frozen—the snow might not be permitted to fall down where it was generated, but be carried off to some distance from where it was taken up, and thrown down in such quantity as to cause, by its weight and cooling effect together, the wind to blow outwards in all directions from its place of descent. Many such places might be formed in a storm, 500 miles in diameter, and, of course, many irregularities be produced, similar to the one in question. These particular, violent, upmoving currents, and down-falls of snow by their side, would be very likely to occur in the neighbourhoods of hills and mountains. For, the air rushing in towards the centre of the general storm, on coming to a hill, will glance up it, and, having acquired an upward motion, will be inclined to continue it, and thus produce the effect in question. For if the hill is very lofty, as the Himalehs, the snow will be thrown down on the windward side; but if it is of moderate elevation, the snow may be thrown down on the leeward side. In the former case the wind may be forced down the side of the mountain on the windward side at the surface of the ground, whilst a few hundred yards high, it may be blowing up the mountain over that at the surface of the earth blowing downwards. This is probably the case in what is called the *helm-wind* in England.

It is also known that a violent summer's shower often causes the wind to blow outwards in all directions from the falling shower, when a few minutes before it had been blowing the contrary way, towards the forming cloud, and the wind at some considerable distance from the falling shower, still continues to blow towards the rain, glancing up over the out-moving current. In this way, new columnar clouds are seen to form rapidly to the windward of the rain cloud. If, during the progress of a great storm, it should sometimes snow or rain violently, and at other times stop, with increase or diminution of wind, it might be safely inferred that some such action as that just described is going on. In that case, too, a person below the clouds may sometimes distinguish these cones, which raise their tops above the general level of the cloud above, for their bases will be much blacker than the surrounding clouds. After all, we must wait for future and more abundant facts to explain these irregularities.

As to the direction in which the storm moved and its velocity, we have but little to say; because it is entirely beyond the power of the theory to predict in what direction storms in general will move. It is highly probable indeed, that very narrow storms of great violence, such as tornadoes, in

which the drops of rain are not permitted to fall back through the ascending current, but are thrown outwards, at a great height, frozen into hail, will all be found to move in the direction of the upper-current—that is, westwardly, or, towards the west in the torrid zone, northwardly from the tropic of Cancer to latitude 30, and northeasterly, or eastwardly in the latitude of Philadelphia.

For the tornado cloud, forming only when the dew-point is very high—that is when the steam-power in the air is very great (for all storms are produced by steam-power,) it will rise very high, and of course a large portion of its upper part, being in the upper current of air, it will be pressed by that current in its own direction. Therefore the tornado, as long as it lasts, must move in that direction. But in case the rain falls down through the base of the cloud, as in ordinary showers, the descent of the rain produces a disturbing force below, and the accumulation of drops of rain in the cloud prevents the cloud from rising so high into the upper current as in the tornado cloud, and besides the air, on the northern border of the storm being colder and of a lower dew-point, will, by its greater weight, have a tendency to press the storm towards the south, and these forces not being exactly known in quantity, we must wait till a patient induction from accumulated facts shall solve this most interesting problem.

Another highly interesting question can only be answered by very numerous observations with the barometer. How far is the snow and rain carried by the out-moving current above, beyond the up-moving current in the middle of the storm?

This distance will no doubt vary with the violence of the storm. In a case of great violence, if the storm is quite narrow, the upward current in the middle may be so great that the snow or rain may not be permitted to fall in the centre of the up-moving current at all—but be compelled to pass outward above in all directions, and fall down in an annulus, where the baromter may even be above the mean, and rise during the fall. Something of this kind seems to have taken place in the present storm, in the northern part of Pennsylvania, extending from Sunbury and Silver lake, even as far down into the centre of the State as Bellefonte. For, at the two former places the barometer did not fall at all, and at the latter, its fall was hardly sensible. At these places, therefore, it is highly probable, there was no upward current of air, and consequently the snow which fell there, must have been generated at a distance. How far this fall of snow may have been, not only the cause of the irregularities at Silver Lake and Meadville, which were mentioned before, and of the very gentle winds about this region, but also of the general tendency of the winds to move on the east and west side of the storm towards a point south of the centre, it is not necessary for me now to determine; at present it is sufficient to have pointed out this source of irregularity, and leave it to future investigation to determine its exact amount.

Another highly important question is suggested here—how far beyond the boundary of the falling rain or snow in these wide extended storms, does the wind blow inwards towards the storm? And how long before the beginning of the rain or snow, does the wind change in front of the storm? It seems probable that the time and distance to which the in-blowing extends, will be directly as the magnitude of the storm, and the facts ascertained are favorable to this deduction. At Philadelphia the wind changed round by N. to N.E. exactly 24 hours before the rain commenced. At Middletown, Conn., the wind changed about 24 hours before the storm came on. At New Bedford and Northborough, Mass., and at Providence, R. I., the wind

changed round from 30 to 40 hours before the commencement of the snow. But in no case did it become so violent as to attract much attention, until within a few hours of the commencement of the rain or snow. I say rain or snow, for in the northern parts of this storm, it was snow, and in the southern parts, rain and hail. And it is worthy of particular remark, that during the whole progress of this storm as far as our observations reach, the wind was most violent on the N.E. of the storm, and least violent on the S.W. of it. This is what we ought to expect from the rise of the barometer on the N.E. side of the storm, as mentioned before. I have in my possession proofs that this is the case in *some* other wide-extended storms; further investigation must decide whether it is the case in *all* such storms.

Even in those very narrow storms called *Spouts,* I have been informed by eye-witnesses that some have the trees thrown down contrary to the motion of the spout along the surface of the earth. Such has not been the fact in those spouts which I have visited. In all I found the tops of the trees on the south side of the spout lying towards the N. E., on the north side towards the S.E., and if occasionally trees were lying across, those underneath were thrown inwards and backwards, and those on top were thrown inwards and forwards. The Brunswick spout of the 19th June, 1835, affords a well known example of this, an account of which is given by A. D. Bache, President of the Griard College, in the transactions of the American Philosophical Society, and also by Professor W. R. Johnston, in the Transactions of the Phila delphia Academy of Natural Sciences.

Another remarkable fact will not escape the observation of the reader, who examines with care the report of this storm. The wind on the 16th, before very much rain and snow had fallen, was every where feeble and irregular, and especially so in the New England states; but on the 17th, when much rain and snow had already fallen, the wind became strong, and the irregularities nearly ceased. So on the western border of the storm, at Wilmington, for instance, the wind was much stronger on the 17th than it had been on the 16th.

The several links of our chain of argument may now be exhibited in juxtaposition.

1. The air did blow inwards towards a region not far from the southern border of the storm.
2. The air did therefore ascend over that region.
3. It cooled a little more than one degree of Fahrenheit for every hundred yards of its ascent, as is known by experiment.
4. When it ascended as many hundred yards as the temperature of the air was above the dew-point, the vapour in the air would begin to condense into cloud.
5. When the vapour began to condense, its caloric of elasticity would be given out to the air in contact with the condensing vapour.
6. This caloric of elasticity would change the law of cooling, in ordinary states of the dew-point, from one degree for a hundred yards of the ascent to one-half a degree, so that the air *in* the cloud was one-half a degree warmer than the air on the *outside* of the cloud, for every hundred yards above its base.
7. The specific gravity of the cloud will thus be less than that of the air at the same height, a quantity which can be calculated if the dew-point and the height of the cloud are given.

* It has since been ascertained that the wind on the 17th, was extremely violent all day at Emmitsburg, Maryland, from N. to N.W.

8. The air in the cloud will therefore move upwards in the middle, and outwards above, and inwards below, with a depression of the barometer under the cloud, and a rise all round the cloud, produced by the outspreading of the air above.

9. If the depression of the barometer is given, the velocity of the upward motion will be known, at least in the case of tornadoes or spouts.

10. If the velocity of upward motion is known, the quantity of vapour condensed in a given time is known.

11. The commencement of this upward motion may depend either on a higher temperature, or a higher dew-point than in surrounding regions.

12. The barometer would probably rise more on the N.E. side of the storm than on any other side, on account of the general motion of the upper portion of the atmosphere, being towards the N.E. in this latitude.

Franklin Institute.

Circular of the Committee on Meteorology.

Sir:—The occurrence of a storm of unusual violence, on or about the 11th of September, current, induces the committee again to address their correspondents and others who may feel an interest in the promotion of Science, to request of them such information as they may be able to furnish upon the following points;

1st. When did the storm immediately preceding the 13th September 1838, commence and terminate?

2nd. In what direction did the wind blow, and with what force during the storm?

3rd. Was there much or little rain? If the observer was beyond the boundary of the storm, how did the wind blow as to strength and direction during the 11th 12th, and 13th?

Should the committee receive such answers to their questions as may enable them to ascertain the chief phases of this storm, it is their intention to publish a report of the same, which they will have pleasure in transmitting to you.

The reports received relative to the storm of the 16th, 17th and 18th of March last, have been collated, and will be published in a few days, accompanied by a map of the United States, upon which is delineated the apparent path of the storm; copies of the report and the map, will be forwarded to the correspondents of the committee at an early day.

Any further facts relating to this storm, particularly from Maryland, Virginia or North Carolina, will be highly acceptable.

Communications to be addressed to William Hamilton, Actuary—Franklin Institute, Philadelphia.

Robert Dungleson,
Alex. Dallas Bache,
James P. Espy,
Charles N. Bancker,
John K. Kane,
Henry D. Rogers,
Sears C. Walker,
Robert M. Patterson,
John C. Cresson,
Gouverner Emerson.
Committee on Meteorology.

Philadelphia, September 18th, 1838.

Mechanics' Register.

LIST OF AMERICAN PATENTS WHICH ISSUED IN DECEMBER 1837

With Remarks and Exemplifications by the Editor.

386. For an improvement in the *Machine for Sawing Shingles;* Zebulon Sargent, Contocookville, Miama county, New Hampshire, December 1.

This machine is dependent for its novelty upon the particular arrangement of its parts, for the effecting of an object which is accomplished by a large number of shingle machines, the claim being to "the mode of gauging the thickness of the shingle, and vibrating the bolt, so as to present alternately a tip and a but to the saw, in the manner described; and to the combination of the various parts as described, for running back the carriage."

387. For an improved *Cooking Stove;* Nathaniel Walker, Dighton, Bristol county, Massachusetts, December 1.

"What the inventor claims as original, and invented or discovered by himself, is the movable sliding box and grate for burning anthracite coal, constructed as described; the particular manner of dividing the fire room into an upper and lower chamber; the dividing the upper chamber into two apartments for the purpose of insulating either chamber, and directing the whole power of the fire into either, by means of the damper before described; and the manner of affixing the sliding plate between the fire room and the oven, by which the bottom of the oven is made accessible."

The foregoing is a formidable list of claims, yet the stove to which they refer, is in its general construction like many others; the things claimed to be done, have, generally speaking, been previously effected, but the mode of accomplishing them is varied; whether those who use this stove will find these variations to constitute real improvements, is a question which they may answer.

388. For an improvement in the *Steering Wheel, for Ships and other Vessels;* Andrew Thorne, Boston, Suffolk county, Massachusetts, December 1.

The wheel referred to, is the common vertical steering wheel, which may be made to act directly upon the barrel on which the steering rope is wound, or may be disengaged so as to turn independently of it, when it may be thrown into gear with a spur wheel and pinion, to increase the effect of the power applied. The claim is to "the combination with the steering wheel of a series of toothed wheels of varying diameters, arranged and brought into gear as described, or by any other of the known or common methods by which a change may be easily and instantly produced in the effective power, by a change of gearing, so that the man at the wheel can at pleasure give to it a greater or less power over the tiller, as light, or strong winds may render necessary, or desirable."

The mode of engaging and disengaging, applied to the steering wheel as

described in the above named patent, is common in machinery of various kinds. It is, for example, used in capstans, and, probably, has been employed on steering wheels also; but, of course, this was not in evidence, or the patent would not have issued; it will be seen that no pretence is made to any novelty in the manner of changing the gear.

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389. For an improvement in the *machine for Sizing Paper;* John Ames, jr. Springfield, Hampden county, Massachusetts, December 1. (See Specification.)

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390. For improvements in the mode of constructing *Saw Mills, for Sawing Timber;* John Ambler, city of Philadelphia, December 1. (See Specification.)

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391. For an improved *Machine for preparing Ice for Shipping and Storing;* Nathaniel J. Wyeth, Cambridge, Massachusetts, December 1.

This machine consists, principally, of an iron frame which may be about three feet long, and two feet wide, the parallel sides having iron plates upon them, the lower edges of which are to run in grooves previously made in the ice to guide them. There are to be steel cutters, held in place like the cutting iron of a grooving plane, which are to cut the ice, as the machine passes along. It is to be drawn by a horse, and to have a man seated on it, whose weight will cause the cutters to operate. There is, also, a cutting knife, which crosses the machine, and is to shave off the surface, when necessary to remove snow, or other matter, therefrom. The claim is to "the combination of the various parts and portions described, in such a manner as to form the machine aforesaid."

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392. For improvements in the construction of the *Saw Cylinder for Cotton Gins;* Jacob Idler, city of Philadelphia, December 1.

This patent is taken for the employment of metallic rings between each of the saws, in order to keep them apart. These rings are to be cast with arms, in the manner of ordinary cast wheels; the spaces between the wheels will, it is said, allow room for the buckle in any of the saws to be relieved without the edges being affected thereby. An iron shaft is to pass through the centres of these disks, and of the saws, which are to be wedged, or screwed up, in the ordinary way.

The claim is to "the forming the cylinder of the said cotton gin with hollow cylindrical metallic sections; with projections or bearings on the sides of the arms and ends of the sockets of said sections, for sustaining, in conjunction with the sides of the rings or sections, the circular saw plate, in a firm and true position on the shaft, and parallel with each other; the spaces formed between the arms and bearings, allowing room for the swellings or bucklings of the saws, so that the part of each saw plate outside of the cylinder, which runs between the ribs or combs of the gin, shall always be true and even."

We believe that gin saws are not now usually made of round plates of steel, like circular saws, but of two, flat semi-hoops, the inner edges of

which are confined between the disks by which the saws are divided; these are cheaper than whole plates, and are less liable to buckle.

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393. For improvements in the *Machine for Steaming and Mashing Apples;* John Dimm, Greenwood, Juniata County, Pennsylvania, December 1.

This apparatus is to prepare apples for fermentation by steaming and crushing them, so as to reduce them to a pulp, or pommage. A rectangular box is made, across which there are two fluted rollers for crushing the apples; this box is surmounted by a hopper, having a close lid, to retain the steam which is to be introduced into it. Above the crushing rollers there is a horizontal sliding shutter, fitting the box, and supporting the apples in the hopper. This shutter is made of two boards placed one above the other, and having a space between them into which the steam is to be introduced through a suitable tube.

The upper board is perforated, so as to allow the steam to pass through, and to act upon the apples in the hopper; when they are sufficiently steamed the sliding shutter is withdrawn, and the apples then rest on the fluted cylinders. Motion being given to these, by a winch, the apples are reduced to pulp, and fall upon an inclined trough below, which conducts the pulp away, prepared for the fermenting tub. The claim is to "the combination of the steaming apparatus with the mashing cylinders, for mashing apples, as above described."

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394. For an improved *Excavating Machine;* Thomas Claton, Shelbyville, Shelby county, Indiana, December 1.

Claim. "I do not claim the employment of a box, to receive and carry off the earth; but what I do claim, is the form of the bottom of the plough, being made with two plane surfaces, instead of curved, as is usual; the line forming the angles of these planes, being so situated that the weight of the earth, when the box is full, will throw the front of the plough up, as set forth."

This plough, as it is called, resembles the common scraper in having a cutting edge in front, and a box to receive the earth. On one of its sides there is a beam like that of the plough, and carrying a coulter. The share, or cutting edge of the box, runs obliquely, to cause it to cut the more easily.

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395. For an improvement on the *Plough;* Stephen McCormick, Fauquier county, Virginia, originally patented by him on the 28th of January 1826: December 1.

The claims must suffice to give all the information we can afford respecting this plough; they are to "the curved form given to the heel of the landside, and also the concave form given to its back edge as it rises from the heel to the beam. Also the manner of stocking the plough; likewise the cast-iron claevis, formed and attached to the beam, as set forth; that is to say, embracing the beam by its concave part, and having a ridge let into the beam, and the bolt inclined backward to resist the direct action of the draught."

396. For an improved *Machine for Sawing through Trees, &c;* Samuel H. Hamilton, city of New York, December 7.

This is an ingeniously contrived machine, intended, principally, for the purpose of sawing down trees, but which may also be adapted to the cross-cutting them after they have been felled. The machine is to be drawn from place to place upon two wheels. The saw is made stiff, as it has no straining frame, but stands out from the machine like a key-hole saw from its handle. The gearing by which it is driven is operated upon by means of a vertical wheel, which is turned by a winch. This acts also as a fly wheel, and is at the same time bevil-geared into a horizontal wheel which gives motion to the crank that operates on the saw. The frame of the machine is sustained, in front, upon a roller resting on a curved way, and this frame turns on a vertical shaft in the centre of the curvature of the way, allowing the frame, with the projecting saw, to move round, so that in the operation of cutting it may be made to bear continually against the tree; a weight hanging over a pulley serves to keep it up to its bearing. The claims need not be given, as they refer to the arrangement of the respective parts, as described.

Under particular circumstances, trees may, no doubt, be advantageously cut by such a saw; but for felling in the woods we do not look for any thing superior, or equal, to a good American axe and axeman. Such a machine as that described, cannot be moved about in the woods in a new country; and in most situations whilst it was being prepared, and anchored, the axeman would be able unaided, to complete the work. There are other serious objections to sawing machines for felling. The saw will bind in the kerf, in spite of all precautions; even the wind alone, were there no other cause, would frequently produce this effect. The axeman can always determine one of two ways in which his tree shall fall, but not so with the manager of the saw; and woe to his machine, when a tree falls upon it, an event which is not only possible, but very probable.

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397. For manufacturing *Boots and Shoes of India Rubber;* Stephen C. Smith, city of New York, December 7. (See Specification.)

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398. For improvements in the *Action of Piano Fortes, and in the mode of giving stability to such instruments;* Thomas Loud, city of Philadelphia, December 7.

Claim. "The improvement claimed, and wished to be secured by Letters Patent, in this modification of the action, (the front motion grand action) is the application of the jack, or grasshopper, immediately to the hammer block, with a front motion, or towards the centre of the hammer, together with the front regulation of the jack, or grass-hopper, when the jack is thus applied at once to the hammer block. And also in what I denominate my *metallic supporting brace*, in the turning pins or long block, of piano fortes, to form supports to the metallic plates by braces, tubes, or otherwise, for more than one point of its strain; the said supporting brace being continuous, either in one or more pieces, and being placed in, or attached to, the turning pin, or long block, to receive the strain from the metallic plate, arising from the tension of the strings, either by its touching the plate, or by braces or tubes attached to it in the manner, or upon the principle, herein fully made known; also, in the detached metallic plate, in the detaching of the plate from the back end of the case, except at the ends of the plate where it is screwed to keep it level."

399. For an improved mode of *applying heat to Cooking Stoves;* Jonathan G. Hathway, Painsville, Geauga county, Ohio, December 7.

This stove is generally to be constructed with two ovens, one above the other, and the fire compartment is to be over the upper oven. Sometimes, however, there is to be but a single oven, whilst the other parts which are depended upon as the foundation of a claim, are still retained. The novelty consists in the particular manner of conducting the draft through the flues, and of governing it by dampers. The claim made is to "the constructing of a cooking stove with the fire place in the upper compartment thereof, and the oven, or ovens, beneath the fire, and having the flues arranged and regulated in the manner set forth." The former part of this claim, that to the locating the fire above the ovens, is very old, and it is therefore only in its combination with the flues, &c., that it could be sustained. The destruction of the models and drawings in the Patent office, is a circumstance very often favourable to applicants for patents, as some thousands of obsolete devices have been thereby removed, without a vestage of evidence remaining of their ever having existed. Many patents are passed in the office respecting which there is a firm conviction on the part of the examiners, that they are taken for what is really old; but where this conviction is not such as would amount to positive testimony in court, the application is not refused.

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400. For an improvement in *Door Springs*; Thomas Thorpe, West Cambridge, Middlesex county, Massachusetts, December 7. (See Specification.)

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401. For an improvement in the mode of *Forming Blocks for Printing Colours on Silk, Linen, &c.*; John Crabtree, city of New York, December 7.

The object in view is to obviate the difficulty arising from the shrinking of the blocks, or from other causes whereby the mitre joinings of the patterns are rendered imperfect. The angle pieces are made in a solid block, upon which the corner pattern is formed, with its mitre. The same blocks may contain other portions of the pattern, so that other pieces for filling up will complete it. The claim is to "the forming of the angle blocks in one piece; and to the general arrangement resulting therefrom."

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402. For an improved *Parlour Stove*; Jordan L. Mott, city of New York, December 7. (The Specification of this stove will appear in the succeeding number.)

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403. For *Water Proof Mail Carriages*; Basil B. Pleasants, Brookville, Montgomery county, Maryland, December 7.

The patentee says, "I make the body of the carriage, or wagon, cylindrical, or nearly so, and construct it of metal or of straight pieces of wood, or staves, which are bound together by strong hoops of iron. There is a strong head let in at each end of the cylinder, in the manner of barrel heads; and on the outside of these heads I form suitable receptacles for the way mails, and for the baggage of the passengers. On the upper part of the cylinder I make an opening which is provided with a door, properly secured by hinges on two sides thereof, and rendered water tight when

closed, by surrounding the edge of the opening with india rubber, or other suitable material prepared for that purpose, so that when pressed upon by the door every interstice will be closed, and the admission of water, or any moisture, prevented. The body of the cylinder is to contain the great mail in its transition from one distributing office to another." This cylinder is to be supported on a carriage, provided with thorough braces, and other means of hanging it. The door is made capable, by the double hinges, of being opened on either slide. A seat is proposed for three or four passengers, and it has a gig covering; below this, in front, is a seat for the driver. The claim is to "the constructing of the body of the wagon, or carriage, in a cylindrical form, and having a door opening into it as described; a receptable at the end for the way mail or baggage, and the seat for passengers combined therewith; the whole arranged substantially as set forth."

This was one of several devices brought forward in consequence of a proposition from the General Post Office, to give a premium for the most approved mail carriage. Of the plans offered this alone sought the sanction of a patent, and there the matter is likely to rest.

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404. For a method of *Preserving Iron and Steel from Oxidation*; M. Sorel, Paris, France, December 7. (See Specification, p. 52.)

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405. For an improved mode of *Colouring and Finishing Leather*; Harman Hibberd, Utica, Genesee county, New York, December 15.

Claim. "What I claim as my invention is the using of the ferro-prussiate of potash in forming a black on leather; and also using sulphuric acid and nitrate of copper in colouring vegetable oils and varnishes to be applied to leather, without an additional body which would diminish their tenacity or lustre; likewise the application of heat, with cylinders, in the finishing of leather in the manner described." There is much empirical matter in the specification of this patent, and from this cause we are deterred from affording space for the whole of it on our pages, as we much doubt its proving the means of advancing the chemical, or the mechanical, arts.

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406. For an improvement in the *Water Wheel*; Charles Goulding, Mobile, Alabama, December 15.

This wheel, we are informed, is "to be driven by water power in such a manner as that the whole pressure of the water in the fountain is constantly pressing on buckets, or valves, on the periphery of a revolving cylinder, without allowing any part of it to escape until it arrives at the issues in the sides of the machine, thus driving these buckets, or valves, and cylinder around." The particular construction is then described, and a claim made to "the whole in the manner described." The granting of the patent goes to show that this wheel was supposed to possess some novelty, but is no guarantee for its utility. We are of opinion that by giving a particular description of it, we should render no valuable service either to the inventor, or the public; the attempts to cheat water out of its natural powers and rights is one of daily occurrence.

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407. For an improved *Cooking Stove*; Horace Gleason, Boston, Massachusetts, December 15.

"My invention," says the patentee, "consists in constructing a com-

pact and portable apparatus having all the conveniencies for cooking, to fit into and be heated by a common cylinder or upright stove, to be removed therefrom at pleasure, and placed out of the way when not in use, while the stove remains to warm the room. Thus enabling small families, and those who wish to use economy in rent and fuel to cook in their parlours or sitting rooms without the encumbrance of a common cooking stove."

The apparatus which is the subject of this patent may be made in various forms, but in all of them it has an opening through its bottom and top admitting a cylinder stove to stand within it; the interior of the stove thus constituting a part of the sides of ovens, or other cooking compartments.

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408. For an improvement in the construction of *Boot Trees*; David Hastings, Deerfield, Franklin county, Massachusetts, December 15.

The centre, or slide piece of the ordinary boot tree, is to be divided down its middle into two parts, and these two parts are united by hinges. On each edge of the slide is fixed a plate of iron the whole length of the boot tree, and about three inches wide, curved so as to fit on to the two sides between which the slide passes. There are some other appendages, and a claim is made to "the slide divided longitudinally, and connected together with butts; and the iron plates attached to the said slides in the manner described."

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409. For a machine for *Thrashing Clover Seed*; Jonathan Brooks, Brownsburg, Rockbridge county, Virginia, December 15.

This machine has a cylinder and concave between which the clover seed is to be hulled, or thrashed out. The concave is composed of slats extending from end to end, and of strips of sole leather confined between the edges of the slats, and projecting inwards towards the cylinder. The cylinder is grooved along so as to form it into twenty, more or less, beaters, between which and the leather of the concave, the seed is to be rubbed out. The claim is to "the concave of strips of leather in combination with a cylinder having beaters, constructed substantially in the way described."

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410. For an improved *Machine for manufacturing Wood Screws*; Clement O. Reed, Providence, Rhode Island, December 15.

In this machine the blanks to be cut are held in a revolving wheel; their heads being held in clamps around its periphery, and their shanks projecting out on one face of the wheel, parallel to its axis. The manner of holding them firmly whilst they are being cut is by the pressure of a roller against the jaws of the clamps. The threads are cut by dies upon a mandril, having a guide screw. The claim is "to the manner of feeding the machine by fixing the blanks to a revolving wheel, and thereby carrying them to the proper position for cutting the screw without stopping the machine, as set forth." The general principle, or mode of action, of the revolving wheel is claimed, when employed in such a machine, without limiting the claim to the particular manner of holding the blanks.

A machine for cutting wood screws was patented by Henry Crum, on the 14th November, 1836, in which the screws are held in a revolving wheel; but in this machine they project out around the periphery of the wheel in a radical direction.

411. For *Manufacturing Artificial Stone*; Joseph Woodhull, Wheatland, Monroe county, New York, December 15.

The materials to be employed, are prepared plaster of Paris, quick lime ground to fine powder but not slaked, oxides of iron, and of manganese, calcined by a full red heat; and the kind of iron ore denominated poor ore, or whites, calcined and reduced to fine powder. The proportions to be used are five parts of the plaster, two of lime, one of manganese, one of whites, and four of sand, all estimated by measure. These materials are to be well mixed in the dry state, the whole is then to have sufficient water added to adapt it for being put into suitable moulds; when this is done, stones broken small are to be added, until the mould is full. In from twenty to forty minutes the moulded material may be removed. Variagated marble is to be imitated by using suitable colours, and proper manipulation. For in-door purposes the metallic oxides may be omitted; for outside work the material is to be saturated with linseed oil. The claim is to "the combining together Plaster of Paris, lime, the oxide of manganese, the description of iron ore denominated whites, and sand, all previously calcined, and the whole prepared and managed substantially in the manner set forth."

There will thus be made a very inferior kind of scagliola; an article when well compounded and managed, of great utility and beauty; which is what we dare not predicate of the compound above described. The validity of this patent admits of much doubt, as the combination can scarcely be denominated new, in any respect; at all events, the right extends only to the particular composition as given, and whilst there are many others which are better, equally cheap, and not covered by any special claim, it is apprehended that the right will be of little value to the owner, whilst it will not stand in the way of any one.

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412. For an Improvement in the *Horizontal Water Wheel;* Samuel Curtis, Eagle, Alleghany county, New York, December 15.

Claim.—"Making the horizontal conical water wheel on a perpendicular shaft, and placing the buckets on the sloped sides thereof, in the manner before described; also the use of a leather tapering tube at the end of the tapering trunk, serving as a gate, or valve, for regulating the column of water passing to the wheel, by means of a lever pressing on the same, in the manner before described; also the second described gate, or valve."

We are not disposed to give any further description of the above-named wheel, or of its appurtenances, not being able to furnish any valuable information respecting it.

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413. For Improvements in the *Circumferentor;* James Mc Cann, New Market, Shenandoah county, Virginia, December 20.

The claims made are—"1st, The addition to the compass-box of a Nonius plate for allowing for the variation of the needle; and the method of using the same. 2d. The slides and hooks for securing the sights in a perpendicular position to the bar. 3d. The addition of the sliding sight. 4th. The combination of the counter with the circumferentor."

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414. For Improvements in the construction of *Trunks and Valices;* Matthias Steiner, city of New York, December 20.

The claims made are—1st. To the uniting the top and bottom frames, or

lid and body of the trunk by a metallic hinge, extending the whole length of the trunk, said hinge being riveted to the frames. Strips of metal are also to extend around the ends and front of the trunk, at the place of the joint. 2d. To forming a channel, or groove, within the thickness of the under side of the top frame, to receive a corresponding tongue on the upper edge of the lower part. 3rd. To a mode of securing the trunk by means of a screw-rod, which passes through overlapping staples in the top and bottom parts, and is turned by a kind of screw-driver, and is thus made fast.

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415. For a *Spark Catcher;* William Duff, city of Baltimore, December 20.

The smoke pipe of a locomotive engine is to have a cap somewhat in the form of a sugar loaf; its sides are to consist of a number of slats standing one above another, like the slats of a venetian blind, at an angle of about 45°. This slope is to throw the sparks downwards as they escape from the chimney, which is surrounded by a second cylinder, a small distance from it, allowing space for a receptacle. This outer cylinder flares out at top, and is covered by a cap of wire-gauze. The inside of the flaring part of the jacket has straps of metal around it, arranged also in the manner of blind slats, to arrest any sparks which might tend to ascend.

"I claim the venetian screen made so as to cover the smoke pipe, and throw the sparks downwards; also the application of the strips on the inside of the top of the jacket, which prevent any substances from passing up the sides of the jacket; all applicable to locomotive engines to arrest sparks and extinguish them, and to cause a draft in the chimney; and the application to ordinary chimneys to cure smoking, and to produce a draft in them."

That a draft will be caused by such a contrivance is rather a novel idea; but if it will do this, and cure smokey chimneys, it might be worth while to put several upon some chimneys, to insure success.

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416. For an improved *Floating Dry Dock;* John Thomas, city of New York, December 20.

Claim.—"Having thus fully described the construction of my Floating Dry Dock, and the manner of using the same, I do hereby declare that I do not claim as my invention either of the separate parts thereof, taken individually; nor do I claim the application of floats or trunks from which water is to be pumped out for the purpose of lifting vessels for repair, this having frequently been done; but what I do claim is the making and using the smaller, or end trunks, or floats, which are to be used in combination with the main floats, and are not to admit water, but are to be forced down as the dock with its load rises; the whole combined and operating substantially in the manner, and for the purpose herein set forth."

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417. For an improvement in the mode of constructing *Force and Suction Pumps;* Jonathan Stevens, Newark, N. Jersey, December 20.

There is a peculiarity in the manner of arranging two side pipes, with their valves, alongside of a metallic cylinder, and the claim relates, and is confined, to this arrangement, which does not present any thing new in principle, or which can be advantageously applied to pumps in general.

418. For *Machinery for Spinning Tobacco;* Hiram M. Smith, Richmond, Virginia, December 20.

"My invention consists in the application of what is usually denominated a clutch, to the end of the common spool used in spinning tobacco, to be removed whenever its motion is required to be checked or stopped; and in providing a friction lever, and making the same in combination with the lever and with the clutch; thereby enabling the spinner, at any point in the spinning table, by the single operation of sliding a small rod, which may be done with the thumb and finger, to remove the clutch and apply the friction lever to the end of the spool, and by this means prevent the spool from continuing to revolve after the clutch is removed, which it would otherwise do for some length of time, from the momemtum given it in spinning," &c. &c. The claim is to the combination of the clutch, the friction lever, and the spool, in the manner described.

419. For a Machine for *Hulling Clover Seed;* William M. Barton, Cheek's Cross Roads, Hawkins county, Tennessee, December 20.

A wooden disk is to be placed on the upper end of a vertical shaft, and is to have its upper surface furrowed like a mill stone; this constitutes the runner. Above it is a platform of wood, supported on a frame like a table top. The under side of this platform is to be furrowed like the runner. There is a hole in the centre of a platform, which is surmounted by a hopper for feeding the seed to be hulled. Means are provided for causing the runner to revolve; and also for regulating its distance from the platform. This constitutes the whole machine. The claim is to the "making the runner and cap out of wood, and furrowed in the manner above described."

420. For a Machine for *clearing Burrs from Wool, in the skin;* Erastus Tracey, Poughkeepsie, Dutchess county, December 20.

The skins with the wool on, as imported from South America, are filled with burrs from which it has hitherto been found difficult and expensive to remove them, but with this machine it is said to be readily and perfectly affected. A cylinder is made about two feet in length, and one foot in breadth, and upon this are placed several rows of steel teeth, about an inch long, and an eighth of an inch apart. This cylinder is made to revolve with great rapidity, and the skins are fed up to it by means of a feeding apron passing around rollers, one of which is nearly in contact with the revolving cylinder, and has above it a pressing roller, to hold the skin firmly. The endless apron, with its appertenances, is on a separate frame, which is made to approach, or recede from, the revolving cylinder by means of a rack and pinion. The skin is laid on the revolving apron, and carried forward so that one-half of it hangs down from beneath the pressing roller; it is then moved up so as to be acted upon by the revolving cylinder, and drawn back on the revolving apron, until the first half has been cleaned. The skin is then turned end for end, and the operation completed. The claim is to "a machine having a revolving cylinder furnished with teeth to which the skin, placed upon an endless apron is fed up, and operated upon, as herein set forth."

421. For an improved *Machine for Sawing Staves;* Harvey Holmes, New Marlborough, Massachusetts, December 20.

This machine is to cut the staves lengthwise of the grain of the wood.

For this purpose, a wheel, the circumference of which has the curvature of the stave, is to be fixed on a vertical shaft, and made to revolve by any adequate power. Steel teeth are to be fixed around the periphery of this wheel, and are to project downwards below its lower edge, and they are to be curved in their length in such manner as to adapt them to the curvature of the stave widthwise. This constitutes the saw. The stuff is to be fed up to this by suitable apparatus below. Instead of making a perfect wheel, it is proposed sometimes to make segments only, for cutting the staves.

"What I claim as my invention, is the construction and use of a wheel, or segment, or segments thereof, which wheel, or segment, shall have a radius the same, or nearly the same, with that of the stave to be cut, taken longitudinally; said wheel having teeth on its periphery, which are to be bent lengthwise, so as to cut such stave to the proper curvature transversely."

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422. For an Improvement in the *Cooking Stove;* James Hutchinson, Jr., Lynn, Essex County, Massachusetts, December 20.

The claim refers only to a special arrangement of the dampers and flues, which was viewed as sufficiently novel to pass examination, but which is not of a character to justify a long story.

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423. For an Improvement in *Secret Safety Locks;* William Hobbs, Springfield, Hampden county, Massachusetts, December 20.

This is a contrivance intended to be used, principally, on hasp locks for trunks; it consists in a particular manner of shifting the hasp laterally, and of managing the key in turning it; the device is ingenious, and one which may serve to please the curious, and to induce the sale of a number of trunks; but we do not think it necessary to employ the engraver to represent it.

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424. For an Improvement in the *Thrashing Machine;* Alexander W. Bowling, Front Royal, Warren county, Virginia, December 20.

The principal improvement claimed in this machine is in the mode of putting the parts together, and of holding them firmly in place; a point of very great importance, and which is not sufficiently attended to in most of these instruments. The centrifugal force arising from the very rapid revolution of a thrashing cylinder, has occasioned much maiming, and, in several instances, loss of life. The mode of construction here proposed, is well calculated to insure strength. There are some minor points in this machine which are claimed as improvements.

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425. For Improvements in the *Machine for Grinding Grain;* Oliver Wyman, East Cambridge, Massachusetts; originally patented July 1, 1836. December 20.

The runner of this grist mill is in the form of a frustrum of a cone, with the base downward, and this is enclosed within the stationary stone, which consists of two parts confined together by screws. The runner, as described in the first patent, had a bridge tree below it, upon which the spindle rested. In the improved form, the stone is suspended by the spindle from a bridge tree above it, the spindle being jointed to allow it to play, and having a collet on it which rests in a cup on the upper surface of the bridge tree. The claim made is to the "suspending the runner of the patented mill, from a bridge-tree above the stone, by means of the combination described of rings, key, and pin, by which the runner can accommodate itself to the bed in the most exact manner."

426. For an Improvement in the *Machine for cutting Dyewood and Bark;* Abner McMillen, Bedford, Hillsborough county, N. Hampshire, December 26.

The patentee says, "I am aware that dyewoods have been reduced by circular saws, and other machinery operating on the end of the stick, applied in various ways, but what I claim as my invention, and consider as new in the above described machinery is the construction of the carriage in combination with a cylinder of cutters and a depressing roller, constructed and operated substantially as herein described."

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427. For an Improvement on the *Truss for Hernia*; Josiah Hungerford, Dover, Dutchess county, New York, December 26.

The claim is to a particular mode of reversing the pad, by means of oblique mortises; the mode of connecting the pad to the spring, and of adjusting it in its place. There is but little novelty in the contrivance, and nothing to render this superior to many other trusses.

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428. For an Improved *Steam Generator;* William Creed, Boston, Massachusetts, December 26.

This is a vertical, tubular boiler, the outer case of which is a double cylinder, with water between them. The tubes above the furnace rise vertically and terminate in a drum from which the smoke pipe issues. The claim is to the "constructing two or more tubes in sets, of one piece, uniting at their upper end in a common orifice, where they are connected with a drum terminating in a smoke pipe; the whole being constructed, combined, and arranged substantially in the manner described."

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429. For an Improvement in the *Safety Rail Road Car;* William Kinkead, Elkton, Cecil county, Maryland, December 26.

The claims are to a "method of sustaining the car in case of the breaking of the wheels, axles, &c. in the manner described. And to the manner of constructing the safety hooks with joints or hinges, screw rod and nut, so that said nut can be engaged with, or disengaged from, the centre guide bar, or safety rail, with great facility and despatch, in case of any trivial accident which might arrest the progress of the cars, or in case it might be desired to turn out of the main track."

This is an *improvement* in rail roads such as is frequently devised in the parlour, but which never finds its way on to the track, and which, were it placed there, would prove to be but a transient lodger. A third rail is to be laid in the centre between the ordinary rails, and is to extend up nearly to the bottom of the cars; there is to be a plate on this rail, forming it into a T rail, and from the bottom of the car hooked pieces are to descend, and clip under the top of the said T plate. Rods reaching into the car act upon and withdraw these hooks, when necessary. Should a wheel, &c., break, the car is to rest on the centre rail, and should the car tend to leave the track, the hooks and safety rail are to prevent it.

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430. For a *Ready Binder for binding Newspapers, Sheets of Music, Letters, &c.;* Ezra Ripley, Troy, Rensalaer county, N. York, December 26.

There are two flat pieces of wood, like flat rulers, which are to hold the back edges of the sheets between them. These are acted upon by springs,

simply and ingeniously arranged, so as to produce the desired effect in a very perfect manner. To give a clear idea of the arrangement of the springs, &c. would require a drawing.

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431. For Improvements in *Fastenings for Window Blinds and Shutters*; Elijah Jaquith, Brattleborough, Windham county, Vermont, December 26.

These fastenings are of very doubtful originality, as a number of devices for the same purpose have been patented; a hundred modes of making them, probably, had been the subject of patents, and were removed out of the way of re-inventors by the burning of the office. In its general form, and mode of action, the present fastening does not differ from others, long in use; the only claim made being to the form of the spring which acts upon the catch, which spring is coiled and inserted, like that used in common snuffers; so far as appeared in the office, this was a new combination in the blind fastening.

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432. For an Improved *Separating Link for connecting Rail Road Cars*; C. H. Hunt, and W. Brown, Fredericksburg, Virginia, December 26.

The principal object in view in the construction of this link is, "in case of the engine, or a car of the train, being thrown off the track, for becoming instantaneously disengaged, leaving the remaining portion of the train on the track." The instrument appears likely to answer the intended purpose, and therefore, in some instances, to be of utility; it rarely happens, however, that in the case of a locomotive, or a car, leaving the track, it will itself be removed out of the way of those behind it.

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433. For an Improved *Standard Measure for taking measure for Coats*; Erastus Barber, Boston, Massachusetts, December 26.

This instrument is more simple in its construction than most of those which have been devised for the same purpose, and from this cause, appears to us better adapted to the intended use; in venturing such an opinion, however, it ought to be confessed that it relates to a matter in which we have no learning, and but little judgment. The claim is to "the above described standard measurer constructed so that all the points required in the fitting of the body are obtained from one vertical line, as set forth. Also the fixing the standard measurer firmly in its place by means of straps, or otherwise, thus insuring correctness in operation, notwithstanding the moving about of the person who is being measured."

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434. For an Improvement in the construction of *Locomotive Engines;* Samuel Wright, Philadelphia, December 26.

We expect to obtain a cut of the improved locomotive, which, when ready, will be given with the specification.

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435. For an Improved *Sliding Flue Grate*; Daniel Desmond, city of New York, December 29.

The claim made is to "the drawing out of the flue with the grate, so as to preserve an equally good draught, and yet adapt the grate to the purpose of cooking, or giving out heat into the room."

An open grate is set in a fire place so that it may remain flush with the

front, in the usual manner. Above it is a stationary oven, around the bottom, back, and top of which the flue passes, there being doors in front opening into the oven. The grate may be drawn out, and project far enough from the oven to have boilers placed in openings directly above the fire. A sliding flue is attached to the grate, and passes into that under the oven, preserving the continuity of the draught, whether the grate be shoved in, or drawn out.

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436. For Improvements in the Machine for *Thrashing and Cleaning Grain;* J. A. and H. A. Pitts, Winthrop, Kennebec county, Maine, December 29.

This machine is constructed in the thrashing part like many others; it is combined with a winnowing machine, as has repeatedly been done, and the things claimed are certain special matters and the mode of combining them.

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437. For an Improvement in the *Cooking Stove*; Carrington Wilson, city of New York, December 29.

The claim is to "the plan of carrying the flues up the remote corners of the body of the stove by diagonal plates, and the arrangement, so far as connected with this object, by which the stove is rendered much more compact, and the dimensions of the oven proportionably enlarged."

It will be seen from the foregoing that the only novelty claimed is in the peculiar form given to certain parts of the stove.

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438. For an Improvement in the mode of making *Harness from metallic Heddles, for Weaving*; B. Hartford and W. B. Tilton, Enfield, Grafton county, New Hampshire, December 29.

Instead of the cord usually employed in making the harness, it is to be composed of strips of metal, with eyes made through them for the passage of the yarn.

"What we claim as our invention and desire to secure by letters patent, is, first, the above metallic heddles, formed in one entire piece, with holes therein to admit the weft, and for their support upon the rods, as above described. These heddles are made of tin, or of wire that has passed between rollers to give it the required width and thickness. Second, we claim the heddles with holes fitting closely to the rods on which the heddles are placed. We claim the heddle frame, constructed substantially as described." The rods above referred to are two parallel rods of round iron at the top and bottom of the harness frame, the metallic heddles having holes at each end by which they are connected to the rods.

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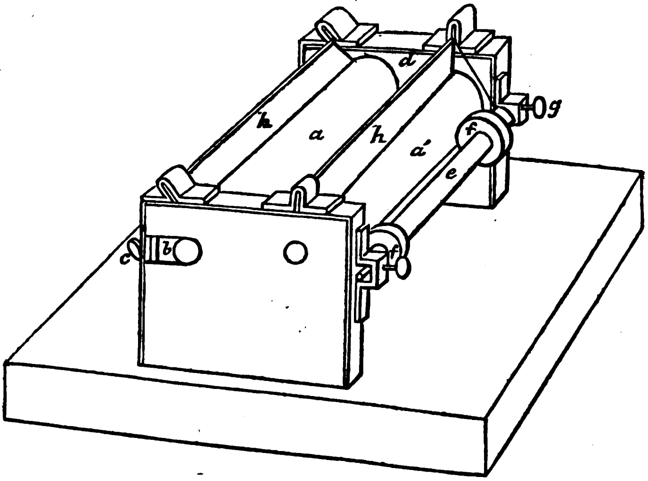
439. For *Fastenings for Saddle Bags, Mail Bags, &c.*; Alvin North, New Britain, Hartford county, Connecticut, December 29.

The claim is to the method described of making the hasps of saddle bag fastenings, and other articles. This is a very trifling affair, and it would be a difficult task to place its merits on record.

Specifications of American Patents.

Specification of a patent for a machine for sizing paper; granted to John Ames, Jr., *Springfield, Hampden county, Massachusetts, December 1st,* 1837.

To all persons whom it may concern, be it known, that I, John Ames, of Springfield, in the county of Hampden, and Commonwealth of Massachusetts, have invented a new and useful improvement in the method of sizing paper by machinery, called a sizing machine, of which the following is a full and exact description.



At a convenient height, I place two cylinders in a horizontal position, and parallel to each other, turning on their respective axes. See, *a*, *a'* in the drawing. I make one cylinder, *a*, of metal, about five and a half feet long, and about nine inches diameter, with a polished surface—the other *a'* of wood, of the same length, but of a diameter sufficient to keep it from springing; and consequently, the diameters of the cylinders may vary in due proportion to their length in all cases. One of the cylinders rests on movable boxes, *b*, which are regulated by screws *c*, or levers, which are so adjusted as to carry the cylinder that they act upon into close contact with the other cylinder when operating.

The paper is brought in a continuous sheet from the paper machine, over a cylinder whose axis is parallel to the axes of the other cylinders, and which is elevated above the others, and so placed that the sheet descending perpendicularly, passes between the first named parallel cylinders—the motion of the cylinders being such as to carry down the paper between them.

That part of the descending surface of each cylinder above their line of contact forms with the descending sheet a trough for the sizing. The ends of the sizing cylinders run against a flat surface, *d*, making a joint close enough to prevent the escape of the sizing.

These troughs are filled, or nearly so, with the sizing prepared in the usual way.

In order to keep up the supply in the troughs, I place a vat, or cistern, containing the sizing in a position higher than the sizing cylinders, having tubes, discharging the requisite quantity into the troughs. Beneath the sizing cylinders, is placed a trough to receive the sizing that passes down between the cylinders at places not in close contact, and it is pumped back into the upper trough, or into the cistern.

By means of the dripping, the edges of the sheet are sometimes, especially in cold weather, apt to be smeared by the sizing. To prevent this I put a strip of fine linen or thin silk around the wooden cylinder *a'*, (when one is used) where the edges of the sheet pass.

These strips serve to make a closer joint, and prevent the escape of any sizing near enough to touch the edges, after passing and being pressed between the cylinders.

If metal cylinders are used, in order to obviate the same difficulty, I place near to the outer surface of the cylinder, which leads off the paper from the sizing machine, and corresponding to its axis, a shaft, *e*, on which are placed wheels, *f*, *f*, with rims two, or three, inches wide.

This shaft is regulated by screws, *g*, or by a lever. The rims of the wheels, which are placed so as to correspond with the edges of the sheet, are pressed with proper force against the cylinder, which turns them by the friction. The edges of the paper are thus pressed and freed from the sizing that may have attached to them.

To clear the cylinders and enable them to present a smooth surface to the sheet, I place upon each a scraper, *h*, *h*, called a "doctor," made of a strip of wood of the length of the cylinder, with an edge of about half an inch thick, covered with cloth. The edges of the doctors are pressed upon the cylinders with force sufficient to scrape off any scurf that may adhere.

What I claim as new and as my invention is the combination of the several parts of the above described machine, in the manner specified, for the purpose of sizing paper without the use of felting, or jackets.

John Ames.

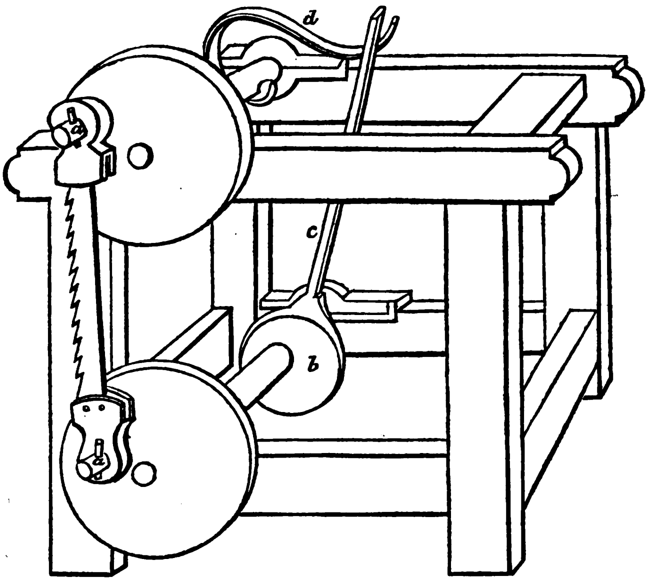
Specification of a Patent for Improvements in the mode of constructing Saw Mills; granted to John Ambler, Jr., *city of Philadelphia, December* 1*st*, 1837.

To all whom it may concern, be it known, that I, John Ambler, Jr., of the city of Philadelphia, and state of Pennsylvania, have invented a new and improved mode of constructing Mills for sawing timber; and I do hereby declare the following is a full and exact description thereof.

Instead of hanging my saw by means of a frame and fender posts, or by means of vibrating levers arranged in any of the various ways heretofore practised, I provide two shafts which are placed in a suitable frame, one over the other, and at such distance apart as shall correspond with the length of the saw to be used; and on one or both ends of these shafts, I form cranks, to which the two ends of the saw, or saws, are to be attached by means of metal blocks affixed on each end of the saw, said blocks having sockets to receive the ends of the cranks.

The accompanying drawing represents such a view of my mill as will serve fully to illustrate the construction and operation thereof. The cranks

a, *a*, are shown as connected to revolving, or vibrating, disks, or wheels, but they may, instead of wheels, be simple cranks, of the ordinary form.



The crank pins may each be at equal distance from the centre of their shafts; in which case, both of the crank shafts are intended to make a complete revolution at every stroke; the length, or throw-out, of each crank should, in this case, be about four inches, but it may be more or less; it being intended, however, in my mill, always to feed, or cut, less at each stroke than with the ordinary mill saw, and to give a more rapid motion thereto.

I do not intend, in general, to make both the cranks of one length, but to give a throw-out to the upper, of from five to eight inches, and to the lower, from three to six inches; the consequence of which will be that when the lower shaft is made to revolve by the application of any suitable power, the upper will vibrate backward and forward, performing a part of a revolution only, the extent of which will be determined by the relative lengths of the cranks. To keep the saw on a strain, I fix a spring, or a weight, so that it shall act upon the shaft of the upper crank, so as to draw it round from the saw. A spring is to be preferred to a weight, in this case, as any desired degree of tension may be given to it.

The spring may be fixed in various ways, so as to produce the desired action, but in all cases it should be so connected and arranged as that the greatest tension should be given to the saw at the period when it is rising. One method of effecting this is shown in the drawing.

An eccentric, *b*, is placed upon the lower shaft, and surrounded by a hoop, from which the rod, *c*, ascends, which rod is attached to the outer end of a coiled, or curved, spring, *d*, the inner end of which is fastened to the upper shaft.

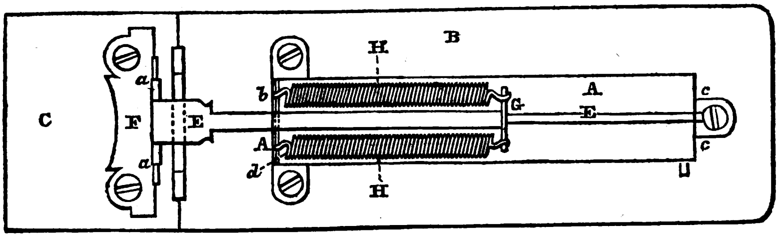
What I claim as my invention, is the hanging of Saw Mill Saws upon rotating, or vibrating, cranks, substantially in the manner herein described.

JOHN AMBLER.

Specification of a patent for an improvement in Door Springs; granted to THOMAS THORPE, *West Cambridge, Middlesex county, Massachusetts, December 7th,* 1837.

To all persons to whom these presents shall come, Thomas Thorpe, of West Cambridge, county of Middlesex, and State of Massachusetts, sends greeting.

Be it known that I, the said Thomas Thorpe, have invented a new and useful improvement in door springs. The said improvement, the principle thereof, and the modes in which I have contemplated the application of the same, together with such parts, combinations, or characteristics, by which it may be distinguished from other inventions, and which I claim, I have fully set forth in the following specification and drawings referred to therein.



A, A, represents the outer casing of brass, or other suitable metal, shaped as seen in the drawing, or othe wise properly formed.

B, is the door on which the spring is to be fastened; C, the door frame.

E, is a metallic rod, turning on a hinge at *a*, in the side of the piece of metal F, screwed to the door frame. The rod E, passes through holes in the ends, *b*, *c*, of the casing A, moving freely back and forth in said holes. G, is a cross bar attached to the rod E, in a proper manner, and has connected to each extremity the end of a wound spring, H, H, whose opposite end is confined to the end *b*, of the casing, or to a pin *d*, passing through the sides thereof.

When the door is opened, the springs H, H, are extended by the movement of rod E, through the slots in the ends *b*, *c*, of the casing, and in withdrawing the force applied to open the door, the springs contract, and immediately close the same. Instead of two springs, I may use only one, or I may employ three, or more, should it be deemed advisable.

The main advantage of this spring consists in the exertion of a strong force to close the door, when nearly shut. Other kinds of door springs generally fail in this part of their operation.

I claim as my improvement, the above arrangement of springs, acting on a rod E, and operating in the manner above described.

THOMAS THORPE.

Specification of a patent for manufacturing Boots and Shoes of India Rubber; granted to STEPHEN C. SMITH, *city of New York, December 7th,* 1837.

To all whom it may concern, be it known that I, Stephen C. Smith, of

New York, in the county of New York, and State of New York, have invented a new and improved mode of manufacturing boots and shoes of sheet india rubber, and I do hereby declare that the following is a full and exact description of the process of manufacture.

A cloth, or leather, lining is fitted to the last, and sewed, or cemented, to an insole of leather; over this are then spread with a brush, two or three coats of dissolved india rubber, to render it sticky; the sheet rubber is then cut into the proper shape, and two or three coats of dissolved india rubber spread on one side of it; the sheet rubber is then put on to the cloth lining and rubbed down; the cement on it causes it to adhere to the cloth, a sole of leather, or of india rubber, is then cemented to the bottom—the boot, or shoe is then taken from the last, bound round the top, blacked, and is ready for use.

What I claim as my invention, and desire to secure by Letters Patent, is the making of Boots, Bootees, Shoes, Overshoes, and Slippers, of sheet india rubber, in the manner herein described.

STEPHEN C. SMITH.

English Patents.

Specification of a patent granted to NATHANIEL PARTRIDGE, *county of Gloucester, for his invention of a certain improvement or certain improvements in mixing and preparing oil paints, whereby a saving of ingredients commonly used will be effected.*—[Sealed 8th December, 1836.]

This invention of a certain improvement or certain improvements in mixing and preparing oil paints, whereby a saving of ingredients commonly used will be effected, consists in the application and use of solutions of lime in water, in the mixing and preparing of oil paints, for the purpose of thickening or preparing the oils used in the same, and forming a better vehicle for the various pigments or paints, and at the same time producing economy in the various ingredients commonly used in the mixing and preparing such paints, (that is to say) instead of using oil only in the customary manner as a vehicle for the various pigments or paints, I first saturate rain, soft, or distilled water with lime, and when in a pure state of solution, that is, after that portion of lime which the water will not take up has subsided, and the water remains clear, it will be fit for use.

For preparing paints for the useful arts, I first mix the said lime water with oil in about equal parts or proportions, by placing the same in a proper vessel, and agitating them till they are united or commixed, in which state the combined oil and lime water will resemble thick cream, in consistency. To about two parts of this composition of lime water and oil I add about four parts of ground white lead, by mixing and preparing them in the usual manner. Should the paint made with this proportion of the composition be found too thick, it may be reduced or thinned by adding small portions of oil, when spirit of turpentine is not mixed therewith, as in paint used for out-door work. But when turpentine is used as for in-door work, the paint may be reduced or thinned with turpentine, only without the addition of any further quantity of oil.

For what is called by the painters flatting the works, or for the last coat put on, I mix about four or five parts of the composition of oil and lime

water, with about eight parts of spirits of turpentine, and add thereto as much ground white lead as the workmen may think necessary in order to make the paint for the last or flatting coat of the proper consistency.

I may here remark, that this flatting coat will not only be put on with less trouble, but will also be found more perfect and durable than when turpentine alone is used. Should the workman wish to lay on a thicker coat of paint, he may add more white lead. For wall painting, the walls should be oiled over before the paint is put on. It may be observed, generally, that in all cases where turpentine or dryers are used with this composition of lime water and oil, a less proportion of them is necessary than when oil alone is used; and that if sugar of lead be used as a dryer, it may be dissolved in the lime water before being mixed with oil, when being in a state of pure solution, it will be found advantageous to the colours.

It is proper to notice that Prussian blue, and some of the dry absorbent earths, such as ochres, umbers, or any other colour that may be found not to grind well in the composition, ought to be first ground in equal parts of raw and boiled linseed oil, or boiled linseed oil only, as may be required, to about the thickness of white lead, as usually prepared, and then to be mixed up for painting with the composition. And further, that I have found the following to be a convenient manner of preparing the solution of lime water; that is to say, to about twenty gallons of cold soft water (or if it be distilled the better,) apply three or four pounds of fresh burnt lime, put them into a cask, stir it well about, and let it stand about twenty-four hours, or until the water is quite clear, when it may be drawn off as wanted; it should be stirred up every six or seven days, that the water may be kept fully impregnated with the lime; and that a convenient mode of mixing the lime water with the oil, is by placing the proper proportion in an open vessel, as a tub or bucket, and whisking or beating them well together; or place the same in a bottle or jar and shake them together until completely blended; and further, I would remark, that the mixture of lime water and oil should always be well shaken before being mixed with the pigments: the lime water should be kept from the air, and as cool as possible.

For preparing my improved paints for the fine arts, the colour should be ground in such proportions of oil and lime water, as may be found requisite, as the exact proportions cannot be stated, as they vary according to the nature and quality of the materials used; but it is desirable to incorporate as much lime water as possible, in order to render the paints crisp, or short, to the touch, and transparent. When sugar of lead is used as a dryer, I dissolve it in the lime water, which I consider an improvement.

For preparing a composition, or what is called by artists "maguelph," for the purpose of thinning the paints or colours on the pallet, I mix the lime water and oil together, and then add a little mastic varnish; the more lime water which can be incorporated, the thicker and crisper, or shorter, will be the composition.

Having now fully, and particularly, described the nature of my said improvements, and the manner of carrying the same into effect, I wish it to be understood that what I claim as my invention, and secured to me by the above in part recited Letters Patent, is the application and use of solutions of lime in water, or a composition of lime water and oil, in the mixing and preparing of oil paints for the useful and fine arts severally, such invention being new, and never before used within these kingdoms, to my knowledge or belief.—(*Inrolled in the Rolls Chapel Office, June,* 1837.)

Journ.. of Arts & Sci.

Specification of a Patent granted to Webster Flockton, *of the county of Surrey, for improvements in Preserving Timber from Decay.*—Sealed August 3, 1837.

To all to whom these presents shall come, &c. &c.—*Now know ye*, that in compliance with the said proviso, I, the said Webster Flockton, do hereby declare the nature of my said invention, and the manner in which the same is to be performed, are fully described and ascertained in and by the following statement thereof (that is to say:—)

My invention consists in impregnating timber of various descriptions with a metallic solution, whereby such timber will be preserved.

And I produce the necessary solution in the following manner, which I consider the best and cheapest means of carrying my invention into effect, though I do not confine myself to the precise means hereafter described, as variations may be made; my object being to impregnate timber for any purpose, it may be found applicable with a metallic oxide, as above stated, and as is more fully described hereafter.

In order that my invention may be fully understood and carried into effect, I will describe the method I pursue of combining materials together and applying them to the purpose aforesaid. I take a quantity of tar (either Stockholm, Archangel, or American) which I submit to the process of distillation; and the apparatus, or still, which I use for this purpose is similar to what is called a pitch still, which is made of copper, and is well known, and forms no part of my invention, nor does the process of distillation for separating the essential oil from the tar, which is effected in the manner following. The still which I use will contain about four hundred gallons, but I do not put into it more than three quarters of that quantity of tar of either of the kinds before mentioned. The first product will be the acid of the tar, bringing with it a light coloured essential oil, which separates immediately and floats upon the surface of the acid in the receiver, which I prefer of wood (a cask with one head and furnished with a cock for withdrawing the acid from below being applicable to the purpose.) After some time the acid will cease and the essential oil will come over in a very considerable stream, which I collect from the receiver to the extent of about forty-eight gallons in the whole, including that which came over in the first instance with the acid. The fire is then to be withdrawn and the contents of the still, which by the extraction of the essential oil, has become pitch, allowed to remain in the still until the following morning to cool, when it may be let off by means of a pipe fitted with a brass or iron plug into a large receiver of cast-iron or other suitable material, and finally put into casks for sale.

I will now proceed to describe the combining of the essential oil with the other materials for the making of my "metallic solution." To effect this, I place two or more large casks upright, removing the upper head of each, and throw into them well rusted iron hoops or tin cuttings. I then pump into them one hundred gallons or more, according to the size of the casks, of the essential oil of tar before described, completely covering the metal. This oil I cause to be repeatedly pumped every day from one cask to the other for about six weeks, by which time the oil will have become very black and much increased in gravity, whilst the iron hoops or tin cuttings will appear quite bright and free from oxide. They are then to be taken out and piled up in an open space of ground and set fire to for the purpose of burning off the oil, and afterwards laid by for re-oxidation,

which may be much facilitated by pouring over them a weak solution of common salt and water. When they have been rusted they will be fit for use.

I will now proceed to describe the method I pursue of saturating timber with the metallic oxide. For saturating wooden piles already driven into the sea, forming jetties or piers, I cause an inch auger to be passed down the centre of the piles to the bottom end if possible, or as far down as can conveniently be done, and the "metallic solution" poured down the hole until filled. This is to be repeated as often as may be thought necessary, but generally in a day or two, it will be found oozing through the pores of the wood depositing an incrustation of iron, which, in combination with the essential oil of the tar, resists alike the action of the water, and the attacks of the worm. A wooden plug or tree-nail is to be driven fast into the hole which may be removed by the auger at any time for the purpose of giving the piles a fresh supply. This method is likewise applicable to the wooden sleepers of railways, and in short to all timber, subject to damp or moisture or the attacks of worm or other vermin.

For out-door buildings, liable to dry rot, it is to be used cold, in the usual way of tar or varnish, with a brush; for being perfectly liquid, it penetrates most rapidly, drying completely in eight or ten hours, when a second dose may be given. Applied to the framing and joists of houses they will be effectually preserved from decay, or where dry rot has in any shape made its appearance, so as to be within reach of applying the solution, perfect soundness will be restored to the infected timbers with a total extermination of fungus.

Having thus described the nature of my invention, and the means of carrying the same into effect, I would have it understood that I lay no claim to any of the materials separately, and it will be evident that the means of carrying the same into effect may be varied to suit the particular object to which the invention is to be applied. But I would have it understood that what I claim, is the impregnating timber of various descriptions with a metallic solution (such as I have described) whereby such timber may be preserved.—In witness whereof, &c.

Enrolled February 3, 1838. Reper. of Pat. Inven.

Specification of a Patent granted to Robert Whitfield, *of the county of Surrey, for a composition which he denominates an indelible, safety, and durable black fluid writing ink.*—[Sealed 14th November, 1837.

This invention merely consists in combining a very long list of ingredients in different proportions, most of which are highly combustible, and then setting them on fire by means of a red-hot iron rod, and collecting that portion of them which in the act of combustion would otherwise escape in the state of smoke, and become soot, and also collecting the residuum of the burning operation which is afterwards to be ground up into an impalpable powder, and when mixed with some liquid ingredients, hereafter named, will produce a fine indelible black ink, which the Patentee informs us cannot be extracted from paper, parchment, &c. by any acids or chemical processes whatever, without materially injuring the texture of the material subjected to such a process.

The principal ingredients employed by the Patentee in making the before-mentioned mixture to be subjected to combustion, are the following, and

they are mixed or amalgamated in various proportions; viz. linseed oil, cocoanut oil, Venice turpentine, bullock's blood, loaf sugar, seed-lac, gum arabic finely pounded, linseed and pounded cotton seed, finely purverized charcoal, pomegranate peel, Aleppo nuts, gum kino, solution of India rubber, the very best molasses, or treacle, parchment shavings, ocre seed, burnt horns, the best ivory black and Antwerp black, tartar, Indian borax, cyanuret of potash, a quantity of the best glue finely pounded, Arcadian nuts, and walnut shells. These materials are intimately mixed together in a large iron vessel, and boiled for about ten minutes; the whole mixture is then set on fire by stirring it about with a red-hot iron, and allowed to burn till all the oil is consumed. The smoke arising from the combustion of this mixture is collected in a conical-shaped vessel, which is inverted over it; this vessel is to be made of the very best sheet iron; it will then be found that the smoke will become condensed, and deposit itself in the shape of soot on the side of the conical vessel: and when all the oil is consumed by the combustion, the product, or that which is found in the conical vessel, must be carefully collected, and put into jars; and that part of the ingredients which remains in the iron boiler, or caldron, and which will be found adhering to the sides of the vessel, must be scraped off, and ground upon a stone until it becomes an impalpable powder.

The products thus obtained must be mixed with some liquid materials in about the following proportions:—to one pound of the products above-mentioned, add one quart of the very best French vinegar to about one gallon of hot water, a small quantity of finely powdered gum arabic, and an equal quantity of gum lac; to these must be added a few Aleppo galls, and a small quantity of logwood chippings. The whole of this must be boiled for about ten minutes in an iron vessel, and then poured out into shallow iron vessels, and be allowed to remain for three weeks exposed to the atmosphere.

The patentee says, in conclusion, "I do not mean or intend to claim the exclusive use of any of the materials herein set forth, nor do I intend to confine myself to the exact proportions of combining them, as the same may be beneficially varied; but what I claim as my invention, is the producing an indelible black ink from the products above named, or from the greater proportion of them combined with the liquid ingredients, as above described."*

Jour. Arts & Sciences.

Specification of a Patent granted to EDMUND SHAW, *of the city of London. Stationer, for an Improvement in the Manufacture of Paper, by the application of a certain vegetable substance not hitherto used for that purpose.*—[Sealed September 14, 1837.]

To all to whom these presents shall come, &c. &c.,—*Now know ye*, that in compliance with the said proviso, I, the said Edmund Shaw, do hereby declare the nature of the said invention, and the manner in which the same is to be performed, are fully described and ascertained in and by the following statement thereof (that is to say):—

I take the envelopes or leaves which cover the ears of Indian corn, and put them into a vessel containing water. The water may be pure, or slightly alkaline, or acid; I then boil the water in the vessel, either by steam or

* The above patent is extracted mainly as a matter of curiosity and absurdity.

fire heat, and macerate the aforesaid envelopes or ollicular leaves. When they have imbibed water and become thickened and swollen, so that the matter interposed between the fibres is reduced to a state of pulp or jelly, a slight beating by a fulling mallet, or other mechanical means, will effect a separation of the fibre from the adherent glutinous matter, and washing or rincing with water during the beating, will cleanse it entirely from the glutinous matter.

I bleach the fibre produced as above, by immersing, or immersing and beating or stirring it about in a solution of chloride of lime, or with beating engines, as it is at present practised for the bleaching of rags in paper mills, and the fibre is in like manner reduced to a pulp, and paper manufactured therefrom, or the quality of the paper may be varied by the admixture of a portion of rags or other filamentous substance.

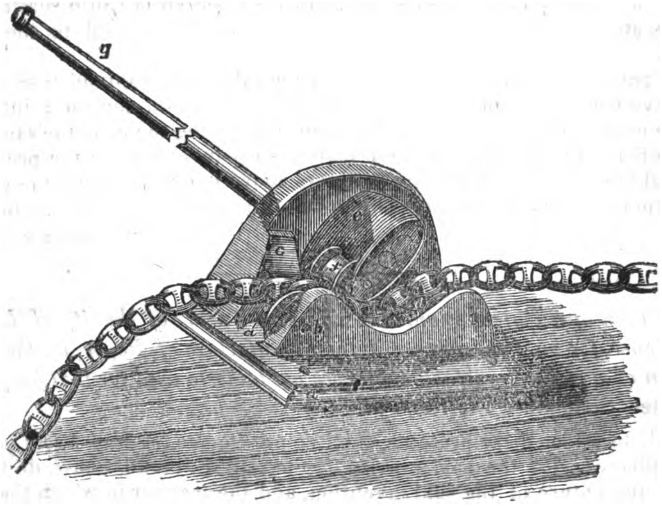
I would remark, that I am aware that some attempts have before been made to produce paper from the above mentioned material, but were abandoned from the incapability of producing good white paper.

What I claim is the mode or process herein described, for making white paper by the application of bleached pulp, produced from the stalks or leaves of Indian corn, which bleached material has not heretofore been so used.

Rep. Pat. Invent.

Baron De Bode's patent Cable Retarder and Stopper.

The cable stopper consists of an iron bed *a, a*, with upright side pieces, *b, c*, supporting two friction rollers, *d, d*; the side-piece, *c*, is higher and



stronger than *b*, and the short lever, *e*, carrying the friction roller, *f*, is connected to the handspike or lever *g*, by a strong axis or pivot, through the side piece, *c*. The action of the apparatus will be readily seen; the lever, *g*, being raised, the friction roller, *f*, will be above, and clear of the cable; as soon as it is desired to retard the chain, depress the lever, *g*, when the

cable will be clasped between the rollers, *f*, and *d, d*; and by further depressing the lever, *g*, so as to bring the roller, *f*, to a nearly centrical position, the chain will be stopped by being clutched between the roller, *f*, and a stud or elevation in the bottom of the stopper.

The following are among the advantages stated by the Baron to be consequent upon the use of his stopper:

Most of the stoppers have not the means of retarding the speed of a running cable which is known to be so pernicious to the men, and articles on deck, and those which can partially retard, can only do it at the destructive expense of both the cable and the stopper, as the cable has to rub through fixed bodies of metal; whereas, in the Baron's it slides between rollers.

The cable being stretched whilst running, when the speed is retarded by pressing the middle roller on it, there is no risk of destructive chafing, as it never gets in contact with the small elevation on the bottom of the stopper, until the middle roller is pressed down to the degree of stopping the cable altogether.

All stoppers hitherto in use stop the cable by pressing suddenly on one link only of the chain, whilst the roller of this one, presenting a larger surface, presses on three links; and instead of stopping the cable suddenly, can but stop it gradually, however quickly the operation may be performed. This must naturally prevent many ruptures, and even the frequent partial injuries to which cables are so subject.

This stopper will answer for a hemp cable as well as any chain of whatever size or figure it may be; whilst the other stoppers in use are still more destructive to hemp cables than to chains.

As the cable never has to force its way through two fixed metal bodies, there is no reason for either stopper or cables wearing out by the operation of stopping.

Most stoppers are by their angular opposition to the strain of the cable, and by their being fixed only to one of the ship's beams, more or less exposed to be broken or torn from their holdings, or even to injure the beam they are attached to, whilst this one, presenting a large basis may easily be fixed to three or more beams, by means of two cross beams underneath the deck; and as it works quite horizontally, it cannot be exposed to capsize, nor to be torn to pieces.

The construction being much simpler and more solid than all others, it is evident, that besides its not being so much exposed to th e above aidents, it must in itself be less subject to repairs.

Lond. Mech. Magazine.

Progress of Practical and Theoretical Mechanics and Chemistry.

On the Manufacture of Glass by the Egyptians.

The authority of Pliny* has been called forth to prove that glass was a late discovery of some Phœnician mariners, who having lighted a fire on the sea-shore, and supported their cooking utensils on blocks of nitre, were taught by the union of the fused substances the secret of this useful invention. The Roman naturalist had fixed no time for this event, and if he

* Plin. xxxvi, c. 26

spoke of improvements in the art, introduced in the reign of Tiberius, it was presumed that, though a vitrified substance was known, its qualities were not properly understood, and that its discovery only dated about the Augustan age. They even objected, that, under the first Emperors, windows were made of a transparent stone, brought from Spain and other countries, called *Lapis specularis;* and they hence inferred the imperfect knowledge of glass.

This stone is now well known under the name of mica; it was only used in the houses of the rich, in litters, or as an ornament to the best apartments, other persons being content with linen, horn, or paper.

Such were the feeble arguments brought forward to disprove the use of glass, for vases and for ornamental purposes, among the Romans; but with much less reason did they apply to its invention in other countries; and though the Egyptians never knew the necessity, or rather the annoyance, of glass windows, under a burning sun, they were well acquainted with vases of that material; and the workmen of Thebes and Memphis, and subsequently of Alexandria, were famed for the excellent qualities of glass-ware they produced, with which Rome continued to be supplied, long after Egypt became a province of the Empire. Strabo was informed by a glassmaker of Alexandria, that a peculiar earth was found in Egypt, without which it was impossible to manufacture certain kinds of glass of a brilliant and valuable quality; and some vases presented by an Egyptian priest to the Emperor Hadrian, were considered so curious and valuable, that they were only used on grand occasions.

Such, too, was the skill of the Egyptians in the manufacture of glass, and in the mode of staining it of various hues, that they counterfeited with success the amethyst and other precious stones, and even arrived at an excellence in the art which their successors have been unable to attain, and which our European workmen, in spite of their improvements in other branches of this manufacture, are still unable to imitate; for not only do the colours of some Egyptian opaque glass offer the most various devices on the exterior, distributed with the regularity of a studied design, but the same hue and the same device pass in right lines directly through the substance; so that, in whatever part it is broken, or wherever a section may chance to be made of it, the same appearance, the same colours, and the same device, present themselves, without being found even to deviate from the direction of a straight line, from the external surface to the interior.

This quality of glass, of which I have seen several specimens, has been already noticed by the learned Winkelmann, who is decidedly of opinion that "the ancients carried the art of glass making to a higher degree of perfection than ourselves, though it may appear a paradox to those who have not seen their works in this material." He described two pieces of glass, found at Rome a few years before he wrote, which were of the quality above mentioned. "One of them," he says, "though not quite an inch in length, and a third of an inch in breadth, exhibits on a dark and variegated ground, a bird resembling a duck in very bright and varied colours, rather in the manner of a chinese painting than a copy of nature. The outlines are bold and decided, the colours beautiful and pure, and the effect very pleasing, in consequence of the artist having alternately introduced an opaque and a transparent glass. The most delicate pencil of a miniature painter could not have traced with greater sharpness the circle of the eyeball, or the plumage of the neck and wings, at which part this specimen has

been broken. But the most surprising thing is, that the reverse exhibits the same bird, in which it is impossible to discover any difference in the smallest details; whence it may be concluded that the figure of the bird continues through its entire thickness. This picture has a granular appearance on both sides, and seems to have been formed of single pieces, like mosaic work, united with so much skill, that the most powerful magnifying glass is unable to discover their junction.

"From the condition of this fragment, it was at first difficult to form any idea of the process employed in its manufacture; and we should have remained entirely ignorant of it, had not the fracture shewn that filaments of the same colours, as on the surface of the glass, and throughout its whole diameter, passed from one side to the other, whence it has been concluded that the picture was composed of different cylinders of coloured glass, which being subjected to a proper degree of heat, united by (partial) fusion. I cannot suppose they would have taken so much trouble, and have been contented to make a picture only the sixth of an inch thick, while, by employing longer filaments, they might have produced one many inches in thickness, without occupying any additional time in the process; it is therefore probable this was cut from a larger or a thicker piece, and the number of pictures taken from the same, depended on the length of the filaments, and the consequent thickness of the original mass.

"The other specimen, also broken, and about the size of the preceding one, is made in the same manner. It exhibits ornaments of a green, yellow, and white colour, on a blue ground, which consist in volutes, strings of beads, and flowers, ending in pyramidical points. All the details are perfectly distinct and unconfused, and yet so very minute, that the keenest eye is unable to follow the delicate lines in which the volutes terminate; the ornaments, however, are all continued without interruption, through the entire thickness of the piece.

Sometimes, when the specimens were very thin, they applied and cemented them to a small slab of stone of their own size, which served as a support on the back, and by this means they were enabled to cut them thinner, and consequently to increase their number.

Wilkinson on the Manners and Customs of the Ancient Egyptians.
Ed. N. Philos. Journ.

On the Composition of a new Indelible Ink. By Dr. Traill.

In a paper lately read before the Royal Society of Edinburgh, Dr. Traill, after an account of many unsuccessful experiments to produce a durable ink from metallic combinations, stated that he was induced to attempt the composition of a carbonaceous liquid which should possess the qualities of good writing ink. The inks used by the ancients were carbonaceous, and have admirably resisted the effects of time; but the author found that the specimens of writing on the Herculaneum and Egyptian *papyri* were effaced by washing with water; and on forming inks after the descriptions of Vitruvius, Dioscorides, and Pliny, he found that they did not flow freely from the pen, and did not resist water,—qualities essential to a good writing-ink in modern practice. The carbonaceous inks with resinous vehicles, rendered fluid by essential oils, though they resisted water and chemical agents, had the disadvantages of not flowing freely from the pen, and of spreading on the paper, so as to produce unseemly lines. Solutions of caoutchouc in coal-naphtha, and in a fragrant essential oil, lately imported from South America,

under the name of *aceite de sassafras* (the natural produce of a supposed Laurus), were subject to the same objections. The author tried various animal and vegetable fluids as vehicles of the carbon, without obtaining the desired result, until he found, in A SOLUTION OF THE GLUTEN OF WHEAT IN PYROLIGNEOUS ACID, a fluid capable of readily uniting with carbon into an ink, possessing the qualities of a good, durable, writing ink. To prepare this ink, he directs gluten of wheat to be separated from the starch as completely as possible, by the usual process, and when recent to be dissolved in pyroligneous acid with the aid of heat. This forms a saponaceous fluid, which is to be tempered with water until the acid has the usual strength of vinegar. He grinds each ounce of this fluid with from eight to ten grains of the best lamp-black, and one and a half grain of indigo. The following are the qualities of this ink. 1. It is formed of cheap materials. 2. It is easily made, the colouring matter readily incorporating with the vehicle. 3. Its colour is good. 4. It flows freely from the pen. 5. It dries quickly. 6. When dry it is not removable by friction. 7. It is not affected by soaking in water. 8. Slips of paper written on by this ink have remained immersed in solutions of chemical agents, capable of immediately effacing or impairing common ink, for seventy-two hours, without change, unless the solutions be so concentrated as to injure the texture of the paper. The author offers this composition as a writing-ink, to be used on paper, for the drawing out of bills, deeds, wills, or wherever it is important to prevent the alteration of sums or signatures, as well as for handing down to posterity public records, in a less perishable material than common ink. He concluded his paper by stating, that should it be found to present an obstacle to the commission of crime—should it, even in a single instance, prevent the perpetration of an offence so injurious to society as the falsification of a public or a private document, the author will rejoice in the publication of his discovery, and consider that his labour has not been in vain.

Edin. New Phil. Journ.

ARTICLES FROM THE FRENCH JOURNALS. TRANSLATED FOR THE JOURNAL OF THE FRANKLIN INSTITUTE, BY J. GRISCOM.

Note relative to the Clarification of the water of the Nile,—and of water, in general, which holds earthy substances in suspension; by FELIX D'ARCET.

Travellers in Egypt have described, with more or less precision, the means generally employed to clarify the waters of the Nile, but they have not attempted to perfect this process, and have not pointed out the mode of operation. My sojourn in Egypt enabled me to study the process carefully, and the object of the following note is to furnish an account of it.

The waters of the Nile are turbid throughout the year, and during the inundation they contain eight grammes per litre, of earthy matters in suspension.

It is always clarified, but more for the purpose of avoiding the disagreeable taste of muddy water, than for objects of health; for many of the inhabitants of the villages of upper Egypt, drink the water as they draw it from the Nile, without being incommoded by it.

Two methods are practised in Egypt, for clearing the water of the

Nile from its slime. The first, employed only by the rich, because it is attended with considerable expense, consists in filtering the water, through porous vessels; the second, which may be practised by all, is effected by means of almonds.

The wealthy have in their houses large jars of porous clay, made at Kenne, a village of upper Egypt. They are placed on a wooden tripod in the most airy part of the house, and are kept constantly full of the water as drawn from the rivers, and the clarified water, which proceeds from them is received in tureens. By choosing the most airy place for the filtering jars, the temperature is somewhat reduced by evaporation, but the difference is scarcely sensible.

Many persons pay no attention to it, and the apparatus is often put into a portable closet to guard the filtered water from dust and insects which might spoil it. Each of the jars alluded to, costs at the factory, 1 franc 10 cent, but at Cairo they cost 3 francs 60 cent: they vary in capacity from 80 to 90 litres or quarts. They must be changed every year.

Every fifteen or twenty days the jars require to be cleaned from the impurities which collect upon them. It is evident that if the filtration was performed by ascension, they would remain clean much longer, but in a country where all the arts are in their infancy,* and where workmen could not be found capable of constructing or repairing the complicated apparatus used in France for clarifying water, for domestic purposes as well as for large manufactories, simple processes can alone be adopted.

The process of clarification first described, is altogether mechanical; —the other is due to a cause more complicated.

After having filled, with the troubled water, a jar much less permeable than those above mentioned, a loaf of almond flour, made for this purpose, is taken in one hand, and with the arm plunged in the water, the loaf is rubbed against the rough sides of the jar, until it is worn down to a mark previously made by the nail. The water is then stirred about effectually by the arm, then covered up and left at rest 4 or 5 hours, at the end of which time the water is clarified. It is the *Sacca*, or water bearer, who performs this office after bringing from the river the quantity necessary for the use of the house.

In rubbing the sides of the jar with the almond loaf, the *Saccas* hear a sharp hissing sound which they deem indispensable to the clarification. Another observation they make, better founded than the last, is that the water will not be clarified if it is agitated during the subsidence of the deposite or if the sediment be stirred up. This is analogous to what is observed in the clearing of wine, when entire repose does not succeed to the mixing of the troubled wine with the isinglass or albumine.

Almonds do not possess, alone, the property of clarifying;—for at Sennaar, at Dongolah, and in Nubia, beans are used and not unfrequently even the castor bean. Whatever the substance employed, the water, seldom acquires by this means, great limpidity, and how long soever the action may be continued, its limpidity remains with every pre-

*How curiously does this contrast with the expression, often used, that Egypt was the *cradle* of the *arts*, and with the undoubted fact that in this very country, almost all the utensils now known, were employed in the earliest recorded periods of civilization. How striking the revolutions which time produces in the condition of nations. Trans.

caution, more or less imperfect. The process of filtration, aside from considerations of economy, is therefore much to be preferred.

We find at Cairo and in all the bazaars of Egypt, the little almond loaves, I have been speaking of. They are made by pounding in a mortar, either sweet or bitter almonds, and afterwards working up the paste into the form and size of an egg.

These almond loaves are sold at 5 parats, or about 4 centimes each. They weigh at a medium 63.70 grains and may serve for a month. The jars used for this purpose are made in the neighbourhood of Cairo, of coarse clay and cost only 70 centimes.

In the last described process, the almonds in this state of minute division, produce a sort of emulsion, the oil unites to the earthy particles, and precipitates, thus facilitating their separation from the water. In this case the almonds act, if we may so speak, in an inverse manner to that of flax-seed cake in the clarification of oil. We know, that after having mixed sulphuric acid with oil to depurate it, a great quantity of parenchyma is carbonized by the action of the acid, and remains in suspension in the liquid, and that when the pulverised cake is stirred in and left at rest, the fecula of the cake, which contains water, unites with the carbonized parenchyma, separates it from the oil, carries it to the bottom and thus perfects the clarification of the liquid. Might we not conclude, incidentally, that flax-seed cake would serve to clarify turbid water?

Perceiving the imperfection of the process adopted in Egypt, for clearing the waters of the Nile, by means of almonds, I attempted to employ alum which has long been indicated, and which my father had successfully used in clarifying the water of the Seine. My results were very satisfactory.

With half a gramme (about 8 grs. troy) of alum to a quart of water, I produced in an hour's time, complete clarification, and the water became extremely limpid. Half the quantity of alum produced the same effect but it required a little more time. The alum produces no unpleasant effect upon the health, for 4 grains or even 8 grains, to a quart are quantities so small that this effect is a perfect nullity. Besides, in this mode of clarification, the alum acts only by undergoing decomposition; the excess of acid it contains is saturated by the carbonate or bicarbonate of lime in the water, and it is only in passing to the state of an insoluble subsulphate, which is precipitated, carrying with it mechanically the earthy particles, that it produces the desired limpidity in the water.

It is preferable, in this process, to employ the alum in large pieces. The best way is to fasten a large crystal of alum to the end of a thread and move it in all directions through the water just below the surface, and taking it out as soon as large flocculi appear. The formation of a sediment is a certain sign that the requisite dose of alum has been dissolved.

If it be desired to use powdered alum, in order to be more certain of the right quantity, it must be reduced to a fine powder, weighed, and then sprinkled on the surface of the water, avoiding any considerable agitation after the salt has been added.

We may also dissolve, in a small quantity of clear water, the quantity of alum we wish to employ, and to pour this solution on the turbid

water, stirring the surface slightly after the addition, and letting it rest. It becomes speedily clarified, and very limpid.

The sediment which alum gives, increases in weight much beyond the limits which the salt would proportionately afford. The quantity before mentioned might therefore be increased without inconvenience. The experiments made in Egypt, were with alum with a base of potash but I think that alum with a base of ammonia would yield similar results.

I recommended, as far as practicable, this mode of clarification, which always succeeded perfectly, during my stay at Cairo, and I hope that in a few years it will be generally followed. They had begun to prepare at the time of my departure, little packets of alum for this purpose.*

Ann. des Ponts et Chaussees.

Note on the Steam Engine of Savery, by Colladen *and* Championniere.

We are in possession of but a small number of exact data relative to the effect of machines, and especially on *motive powers*. Chosen some years ago to give a course on mechanics, at the Central School of Arts and Manufactures, I was obliged often to have recourse to experiments, to ascertain the useful effects of *steam movers*, (moteurs á feu.) The note which I present to the Academy, is a summary of the expeiments I made with M. Championniere, civil engineer, with the steam engine on *Savery's construction*.

In these very simple machines, the steam raises the water by its immediate action. The steam is introduced into a vessel, then condensed, and produces a respiration or flowing in of water.

A second admission of the steam drives the water up into the reservoir.

These machines were the first steam movers employed in large works. They were afterwards abandoned for the machines of Newcomen and Watt.

Several manufacturers, especially Manoury D'Hectol, nevertheless have employed them.

As our experiments may serve to fix the value of these engines, and the conditions under which the employment of them may be preferable, we think it may be useful to publish them.

We possess very few estimates of the power of the Savery machine: —Bradley, Smeaton, Manoury and Girard, have published some memoirs on its effects; but we find in no publication on the subject, the measure of increase of heat in the water elevated, nor of any other element needful to the theory of these motive powers.

But a very small number of the Savery machines are in existence. We know of but *five in operation, three are in the department of the Seine, the fourth in Loire Inferieure, and a fifth at Lyons.* We believe there are none remaining in England.

We have experimented with the three of the department of the Seine. The oldest is at the *abattoir de Grenelle*, and was constructed by Manoury. The two others are in the Vigier baths; they were made by Gingembre.

* Compare this recommendation of alum with the objections made to its use in the paper of Arago on filtration, published in the last number of this Journal.

The following numbers were obtained from these three machines in three series of experiments.

Experiment of the 26th March 1833, on the bath machine of Pont Marie.

Temperature of the water of the Seine,	6¼°
Mean tension of the steam,	3atm.
Water raised per hour,	12.213m.
Height of elevation,	6.6m.
Temperature of the water raised,	10¼°
Dry wood burned during one hour,	30.4k.
Duration of a period,	26.0″

Experiment of the 10th July 1833, with the same machine.

Temperature of the water of the Seine,	19¼°
Mean tension of the vapour,	3atm.
Water raised per hour,	12.724m.
Height of elevation,	6.10m.
Temperature of the water raised,	23½°
Dry wood burned in an hour,	46kil.
Duration of a period,	26″

Experiment with the machine of Manoury D'Hectol.

Temperature of the water of the well,	12½°
Mean tension of the steam,	00
Water raised per hour,	15.400m.
Height of elevation,	14m.
Temperature of water raised,	16½°
Charcoal burned in an hour,	13kil.
Duration of a period,	90″

Agreeably to the first and second tables, the machine of Pont Marie gives 2.595 dynam, to a kilogramme of wood.

This is about eight times less than the effective force of a small piston machine of the same force which would work pumps. But the water raised would have to be afterwards heated, so that we must take into account the increase of temperature, which was four degrees Cent. (= 7½ F.) in the first series, in the month of March, and three quarters in the second in July. Thus, in the first case, each kilogramme of wood sent up to the reservoir, by the action of the machine 1702, portions of heat (caloric) and in the second 1255. With a more complicated machine than that of Savery, an additional heating apparatus would have been necessary, and this addition would have required the same expense.

Thus, whenever water is to be both raised and heated (and this often occurs in manufactories) the almost forgotten machine of Savery is the most advantageous motive power. It is the least costly at first, the least subject to accidents, and to wear and tear, and the most easily managed.

We will add a few words on the comparative effect of the three machines. In all of them the accession of heat was about four degrees, although the Manoury machine differs essentially from the two others.

The last machine performs more than double the work of those of Gingembre, at the same cost. Agreeably to the public report of M. Girard, in the 21st Vol. of *Annales de Physique et de Chimie*, the Manoury

machine gave 20.202 dynam for each kilogramme of charcoal. This result surpasses that obtained by us, whence the increase of temperature of the water must at that time have been at a maximum of 2.8° instead of 4°. This measure is wanting in the memoir referred to.

From the foregoing experiments it results:

1. That the Savery machine is a very valuable motive power which may be advantageously employed in many of the arts.
2. That the use of it ought to be limited to those cases in which water is to be heated as well as elevated.
3. That the machine of Manoury is the best model for imitation.

Ann. des Pontes et Chaussees.

Blasting of Rocks.

Means of kindling a blast, without danger, at the bottom of a well or shaft, without risk of failure.

Very brief notices may sometimes render great service, and when they have the stamp of utility upon them the Ann. des Ponts et Chaussées, will register them with pleasure.

The following will strike every reader by its simplicity; but it may, nevertheless, prevent some fatal imprudencies and save the lives of miners.

We allude to the difficulty of blasting a rock at the botton of a well, or other excavation, where there is no place for the miner to retreat to for safety.

When the priming is furnished with a piece of touch-wood, it is often fired by throwing down burning paper or other ignited bodies; but when the explosion does not take place, after a considerable time has elapsed, it has happened that on going to examine the charge, it has exploded, and death or dreadful wounds have been the consequence. The means, therefore, of safely igniting the match must be a matter of interest. For this purpose M. Devilliers' proposes the following simple method.

The miner, before ascending, fastens a wire to the touch-wood which communicates with the priming, and extends this wire, as he ascends, to the surface; being careful to prevent any knots from remaining in it.

A bunch of touch-wood, pierced with a hole through its centre, is fired and allowed to slide down the wire, giving the operator full time to retreat to a place of safety, while the kindling of the match at the bottom can hardly fail to take effect.

Ibid.

In all ordinary cases, the safety fuse described at page 63 of our last volume, might be deemed preferable to the mode above suggested. We know not whether it (the safety fuse) has been introduced, and used in the United States, or not;—but in point of cheapness the wire guide now proposed, might be preferable, and perhaps it would be as certain in its effect. G.

Report to the Societé d'encouragement, on two prizes,—one for perfecting the fabrication of dextrine, and its application to the useful arts;—the other for the extraction of sugar from dextrine; by M. Payen.

The numerous and useful applications of dextrine obtained by the various means by which starch is disintegrated, make it extremely desirable that this new commercial product should be obtained as free as possible from colouring matter, and of a uniform quality, so that it may, with all its advantages, be used as a substitute for the gums in the preparations of various tissues, both white and of transparent shades,—for coatings and colourings of paper hangings,—for giving a lustre to prints and coloured lithographs,—for extending sheets in drawings,—and other applications pointed out by the Baron de Silvestre.

The society will adjudge a premium of 2000 francs, to the best solution of this question, provided, the author shall manufacture it in such a quantity as to throw into the market at least 600 kilogrammes, per day, of a good and even quality.

The competitors must furnish a complete account of the various uses of dextrine* and indicate the factories or places where the committee may witness its successful applications.

Various laboratory trials and applications in the large ways, have demonstrated that it is possible to convert, by means of diastase, starch into sugar, whiter, purer, and of a better taste than that which is produced by the saccharification of starch by sulphuric acid. The latter indeed, has a styptic taste, and a disagreeable odour, and contains besides, a notable portion of calcareous salt which is injurious in some of its applications. There are other inducements for avoiding the use of a powerful acid in manufactures destined to spread through the country.

The sirops and sugars of dextrine, obtained from germinated grain, are commonly exempt from these defects; but their preparation demands more skill, especially in developing, by means of germination, the greatest quantity of the active principle, and avoiding any injurious change in it. There is some difficulty also, to be overcome, in thoroughly clarifying and filtering sirops, and in evaporating them so as to avoid the production of colour.

The Societè d'encouragement, desirous of rendering the conversion of starch into sugar, an easily attainable object without the intervention of sulphuric acid, offers a premium of 3000 francs, to any one who shall completely succeed in this enterprise, and establish a safe and easy process which may be followed without risk of failure.

The sugar thus prepared must be white, solid or grained, of a free, sweet taste, immediately applicable to the making or improvement of the different kinds of beer, cider and wine,—to confectionaries, preserving fruits, and grapes, to eduleorating drinks, and be decidedly preferable in this respect to solutions of liquorice.

*Starch, in its several varieties, consists, (when examined by the microscope,) of small brilliant spherules, each of which has a coating less soluble than its interior. Heat bursts these envelopes and lets out their contents, which consist of a gum-like substance, to which the name of *Dextrine* was given by Biot. It is much the same as the *Amidine* of Saussure, and of the chemical books. Trans.

It is not required that this product should be a substitute for cane or beet sugar, as the peculiar nature of grape or starch sugar would hardly admit of it.

A manufactory of 300 kilogrammes a day, must be in operation so that the society may witness the process and prove the good quality of the article produced.

The Society holds itself ready to offer premium medals to any one who makes the nearest approach to the object in view, either in preparing sugar or sirop—or in their application.

Bull. d'encour, Decem.

Compensation Pendulums; by M. Wiesniewsky.

It is well known that the system of compensation by mercury, contrived by Graham, consists of a glass vessel filled with mercury, which fastened to a strong rod, performs at once the office of a bob or lens, and of a compensator. But this compensation is very imperfect, inasmuch as it is not affected by the sudden changes which take place in the ambiant atmosphere, and which are often very considerable. To perfect it, M. Wiesniewsky proposes to render the temperature uniform, throughout the pendulum, by distributing the mercury through a number of small hollow iron cylinders, disposed symmetrically on each side of the rod. By greatly increasing the surface of the mercury in proportion to its volume a much more rapid change of temperature will take place in the metal, the rate of which will be expressed by a formula based on experiment, made for the purpose. The equation of the curve of the generating surface of the exterior surface of the iron rod, may then be obtained, a curve which will satisfy the conditions of the problem, viz: that the progress of temperature throughout the whole length of the rod may be always conformable to that which takes place in the mercury.

Ibid.

New process for cleaning cloth from grease; by M. Martin.

This process, which is very easy, consists in washing the cloth in warm water to deprive it of paste or gum, then to impregnate it with a mixture of Fuller's earth, potash or other alkaline material, and, thus prepared, to suspend it in a tight box or receiver and subject it to the action of a jet of steam. When withdrawn, it is thrown into the water and passed between two cylinders to clean it.

The cloth, in this process, receives no fulling, and by means of a small boiler, which costs but little, a large amount of work can be rapidly performed.

Ibid.

Progress of Physical Science.

Simultaneous Meteorology.—No. V.

TABLE OF HOURLY METEOROLOGICAL OBSERVATIONS, made during the 21st and 22nd Dec., 1837, at BLACKHEATH ROAD, near Greenwich, about four miles and a half S. E. of London, *by and under the superintendence* of J. H. BELVILLE, in conformity with the Instructions circulated by the South African Literary and Philosophical Institution.

DATE.	HOUR.	Barometer.	THRM. Attach'd	THRM. In open air.	WIND. Direction.	WIND. Str'gth.	Prop. of Cloud.	STATE OF THE ATMOSPHERE, CLOUDS, &c.
		Eng. In.	F. °	Fah. °				
Thursday, December 21, 1837.	VI. A.M.	29.760	53	42.4	N.	3	10	Stormy high wind; densely cloudy.
	VII.	29.840	53	42.0	N.	3	10	Ditto. ditto.
	VIII.	29.895	53	42.0	N.	2	10	Clouds broken; more moderate.
	IX.	29.958	52	41.1	N.	2	7	Getting clearer. *Sunshine at intervals.*
	X.	30.020	52	41.2	E.b E.	2	5	Passing drops of rain since last obs.
	XI.	30.080	52	41.2	N.N.E.	2	6	Much driving cloud *scud* from N.N.E.
	XII.	30.110	51½	41.2	N.N.E.	1	6	Wind going down. Air getting dry.
	I. P.M.	30.120	52	42.5	N.N E.	1	5	Little or no variation.
	II.	30.136	51	41.5	N.NE.	1	10	The same.
	III.	30.153	51	41.4	N.N.E.	1	10	Getting now more overcast, and no wind.
	IV.	30.200	51	41.0	N.E.	1	10	The maximum by a self-registering thermometer 43°.1.
	V.	30.225	50	40.5	N.E.	1	10	
	VI.	30.294	51	40.8	N.ly.	1	10	
	VII.	30.250	52	40.2	E. b S.	1	10	N. B. Barometer very unsteady for two or three hours.
	VIII.	30.239	51½	39.4	E.S.E.	0	10	
	IX.	30.251	51	40.1	S.	0	10	A completely covered sky, and no variation in its appearance for these 15 hours.
	X.	30.292	51	39.2	S.	0	10	
	XI.	30.268	51	39.1	S.	0	10	
	XII.	30.254	51	39.0	S.	0	10	
Friday, December 22.	I. A.M.	30.250	51	39.0	S.	0	10	
	II.	30.241	51	39.0	S.S.W.	1	10	
	III.	30.208	51	39.1	S.S W.	1	10	
	IV.	30.182	51	39.5	S.S.W.	1	10	The min. by a self-registering therm. 38°.2. The lowest of a radiator on the ground, 37°.
	V.	30.157	51	40.0	S.W.	1	10	
	VI.	30.150	51	40.6	S.W.	1	10	
	VII.	30.132	51	41.0	S.W.	2	10	Clouds a little broken.
	VIII.	30.114	51	42.6	S.W.	2	10	Quite thick.
	IX.	30.100	51	42.9	S.W.	2	10	The same.
	X.	30.090	49	44.1	S.W.	2	10	The same; *scud* swiftly moving from S.W.
	XI.	30.080	50	45.5	S.W.	2	10	The same.
	XII.	30.062	50	46.0	S.W.	2	10	The same; drizzling rain.
	I. P.M.	30.030	51	47.0	S.W.	2	10	The same.
	II.	30.011	51	48.0	S.W.	2	10	The same.
	III.	30.000	51	48.0	S.W.	2	10	The same; sky gets turbid and gloomy.
	IV.	29.981	51½	48.0	S.W.	2	10	The same.
	V.	29.974	52	49.1	S.W.	2	10	The same.
	VI.	29.958	52	49.5	S.W.	2	10	The same.

NOTES.—A violent gale night of the 20th and morning of the 21st, from W.N.W. and N. At 1 A. M, the barometer at 29.32, and as the wind got to the N.W. and

Extract of a letter from Sir John Herschel, to the President of the Royal Astronomical Society, giving an account of a remarkable increase of magnitude of the star η in the constellation Argo, *observed by him at the Cape, December* 16*th*, 17*th*, 1837.

"I have just observed a very remarkable phenomenon, the development of which I am watching with much interest. It respects the nebulous star η in the constellation *Argo*, No. 1281 of the Catalogue of the Astronomical Society, marked in that catalogue as of the second magnitude. As such, or rather as intermediate between the first and second, as a very large star of the second magnitude, or a very small one of the first, I have always hitherto observed it, having in some cases equalized it with *Fomalhaut*; in others placed it intermediate between α and β *Crucis*, nearly equal with the latter, &c.; nor have I at any time had reason to suppose its magnitude variable. To night, however, being at work on my classification of the southern stars in the order of their magnitudes, I was much astonished to find its magnitude superior, not only to that of *Fomalhaut* and α *Crucis* (with which stars it no longer admits of a moment's comparison,) but even to that of *Aldebaran*, *Procyon*, α *Eridani*, α *Orionis*, and little if at all inferior to that of *Rigel*.

"This was my own judgment, and that of several persons whom I called to my assistance, in the early part of the night, when η was low and *Rigel* high in the heavens. At the time I write, they have about equal altitudes, and the comparison is decidedly in favour of η, which is in fact (*Sirius* and *Canopus* excepted,) the most brilliant star now visible; α *Centauri* being too low for fair comparison, and veiled with some degree of haze.

"This remarkable increase of magnitude has come on very suddenly, as my attention has frequently of late been drawn to this star in the lower part of its diurnal circle, while watching with some impatience its progress towards the meridian, at a reasonable hour of the night, that I might resume and complete, before my departure hence, a very elaborate monograph of the wonderful nebula which surrounds it. A few evenings before the full moon just passed, in particular, I remember to

N., it rose at the rate of above 1-10th of an inch in an hour; the thermometer, at noon on the 20th; rose to 55°, a degree of warmth very uncommon on the day preceding the winter solstice.

A remarkably cloudy period; not a star visible during the whole night. The atmosphere was covered with one mass of dense cloud; the sun, likewise, was not once seen on the 22nd.

The time was taken from a good clock, keeping mean time. Rate scarcely perceptible. Error obtained by observation of the ball-drop of the Royal Observatory, Greenwich.

The Barometer has an elevation of 46 feet above *mean high water mark* of the river Thames, carefully deduced by very accurate barometrical measurement. The index error of scale presumed to be within a *hundreth* or two of the truth. The Thermometer, by Dollond, suspended in open air, at an elevation of 40 feet from the ground: aspect, northerly.

The comparative strength of wind is indicated by the figures thus,—0 means no wind perceptible; 1, very light breeze; 2, strong; 3, a gale. In the column headed *Proportion of cloud*, 0, signifies quite clear; 10 no blue sky visible; 5 sky half covered.

have noticed it with this view; and had it then been what it now is, a star of the first class, it could not have passed unremarked.

"Whether it be now at its maximum, and about to decrease by insensible degrees; whether, like *Algol*, but in a much longer time, it remains as it were dormant through the greater part of its period, and runs through its phases of increase and decrease in a small aliquot portion of the whole; or whether, lastly, it be on the point of blazing forth with extraordinary splendour, so as possibly to outshine its brilliant neighbours, *Centauri* and *Canopus*, it is useless to conjecture, and observation will soon determine."

The President read an extract of a letter from Mr. Henderson relative to the remarkable increase of magnitude, in *η Argus*, recently noticed by Sir John Herschel, as mentioned at the last meeting of the Society. Mr. Henderson states that the star is not to be found at all in Ptolemy's catalogue, although the bright stars of the Cross and the Centaur, which culminated as low at Alexandria, are inserted in it. From this circumstance he infers that, at this remote period, the star was not very bright. It is not in Bayer's maps; and in Halley's catalogue it is said to be of the *fourth* magnitude, which is less than some of the neighbouring stars that in modern times cannot competé with it. It would thus appear that the star has for a long period been increasing in brightness; and it will be remarkable if it should surpass the brightest at present known.

Lond. and Edin. Philos. Mag.

Proceedings of the American Philosophical Society.

February 16, 1838—Dr. Patterson, V. P. in the Chair.

Electricity.—Professor Henry, of Princeton, made a verbal communication on the lateral discharge of Electricity while passing along a wire, as in the Leyden experiment, or communicated directly to an isulated wire, or to a wire connected with the earth; and detailed various experiments, proving that free electricity is not, under any circumstances, conducted silently to the earth.

March 2.—Mr. Du Ponceau, President, in the Chair.

Longitude.—Mr. Walker read a paper, entitled "Determination of the Longitude of several Stations near the Southern Boundary of Michigan; calculated from Transits of the Moon and of moon culminating Stars, observed in 1835 by Andrew Talcott, late Captain of United States Engineers."

The longitude of places in the United States, north of the Ohio, had hitherto depended on the observations of Ellicott and De Ferrer, made at points on the banks of the Ohio river, and on meridian lines drawn from this river, several hundred miles northward, by the deputy surveyors. From Mr. Walker's computations, it appears that *Turtle Island, Lake Erie*, has been placed only 1.7 geographical miles too far east on Tanner's Map. Its true place is 41° 45′ 9″ N. latitude; and 5 hours, 33 min. 34.3 sec: W. longitude from Greenwich. Also, *South Bend Lake, Michigan*, has been placed 3.9 miles too far east; its true place being N. 41° 37′ 6″; W. 5 hours, 49 min. 15.3 sec. These observations of Capt. Talcott will prove highly useful to geographers, by furnishing standard points of reference in the northernmost parts of the United States.

May 4.—Dr. Patterson, V. P., in the Chair.

Electricity.—Dr. Patterson read a letter from Professor Henry, of Princeton, dated May 4, 1838, announcing that, in recent experiments, he has produced directly from ordinary electricity, currents by induction analogous to those obtained from galvanism; and that he has ascertained that these currents possess some peculiar properties, that they may be increased in intensity to an indefinite degree, so that if a discharge from a Leyden jar be sent through a good conductor, a shock may be obtained from a contiguous but perfectly insulated conductor, more intense than one directly from the jar. Professor Henry remarks that he has also found that all conducting substances screen the inductive action, and that he has succeeded in referring this screening process to currents induced for a moment in the interposed body.

Fused Platinum.—Dr. Hare exhibited to the Society fourteen and a half ounces of platinum, fused by his hydro-oxygen blowpipe, and a specimen of pure platinum, freed from iridium by the process of Berzelius.

Steam Navigation.—Dr. Patterson submitted to the Society's inspection the log-book of the steam-ship Savannah, Capt. Moses Rogers, launched at New York on the 22d August, 1818; from which it appears that, after repeated voyages between New York, Savannah, and Charleston, this vessel left Savannah on the 24th or 25th of May, 1819, for Liverpool, saw Land's End on the 17th of June, and arrived at Liverpool, on the 20th of June, having used steam thirteen days, and having exhausted her fuel (coal) three days before arrival. It also appears from the log-book that she left Liverpool on the 23d of July, arrived at Elsineur on the 9th of August, left Elsineur on the 14th of August, arrived at Stockholm on the 22d of August, left Stockholm on the 5th of September, arrived at Cronstadt on the 9th of September, and after several excursions between Cronstadt, &c., and Copenhagen, &c., left Arundel, Copenhagen, on the 23d of October, and arrived at Savannah on the 30th of November; that she subsequently arrived at Washington from Savannah on the 16th of December, after a passage of eleven days; that she was sold at Washington in September, 1820, and her engine taken out, after which she sailed as a packet, from New York to Savannah, until September, 1822, when she was lost. This log-book was supposed to derive additional interest from the recent arrival of the Sirius and Great Western, steam-ships, at New York, from England.

Solidifying Carbonic Acid.—Dr. Mitchell repeated before the Society Thilorier's process for solidifying carbonic acid, with an apparatus, made under his direction in Philadelphia, somewhat modified from that employed by Thilorier, and froze a quarter of a pound of mercury by the admixture of the solidified acid with nitrous ether.

May 18.—Mr. Du Ponceau, President, in the Chair.

Elements of Water.—Dr. Hare communicated orally, that he has found that when the elements of water are exploded in contact with certain gases or essential oils, the aqueous elements, instead of condensing, combine with the hydrogen and carbon, and form a permanent gas.

July 20.—Mr. Du Ponceau, President, in the Chair.

Magnetic Dip in Ohio.—The Committee, appointed on the Communication of Dr. John Locke, of Cincinnati, read at the last meeting, made the following Report, which was adopted.

"The Committee to whom was referred the Communication of Professor John Locke, of Cincinnati, report that it gives the details of a series of experiments, made for the purpose of determining the magnetic intensity and dip for certain positions in Ohio. For these experiments he had furnished himself, in London, with the best apparatus, and had vibrated there two needles of the form recommended by Hansteen, and one in the form of a small flat bar. Five months afterwards, namely on the 17th of January, 1838, he again vibrated these needles at Cincinnati, and found the ratio of horizontal intensity at the former place to that at the latter, as follows: by needle No. 1, as 1 to 1.1624; by needle No. 2, as 1 to 1.1639; by No. 3, as 1 to 1.2037. Of these results, the author prefers the last; inasmuch as the magnetism of needles is liable to decrease, but not to increase.

"On the 20th of August, 1837, he made experiments with his dipping needle, to determine the dip at Westbourn Green, near London, the mean of which gives 69° 23′.3.

"On the 26th of Nov. 1837, the mean of a series of experiments made at Cincinnati, in lat. 39° 6′ N., and long. 84° 27′ W., gave the dip = 70° 45′.75.

"At Dayton, Ohio, in lat. 39° 44′ N., and long. 84° 11′ W., the dip was found to be 71° 22′.75 on the 26th of March, 1838.

"At Springfield, Ohio, in lat. 39° 53′ N., and long. 83° 46′ W., the dip was found, on the 29th of March, 1838, to be 71° 27′375.

"At Urbana, lat. 40° 03′ N., long. 83° 44′ W. March 30, 1838, the dip was found = 71° 29.′94.

"At Columbus, the seat of government of Ohio, lat. 39° 57′ N., long. 83° W., April 3d, 1838, the dip was found = 71° 04′.875.

"The interest of this paper is much increased by the circumstance that no accurate experiments on the intensity and dip of the needle have heretofore been made in the United States, west of the Alleghany mountains."

Dipping Needle for finding Longitude.—Dr. Patterson laid before the Society, copies of a Memorial presented to Congress by Dr. Henry Hall Sherwood, and of a Report thereon by the Committee on Naval Affairs of the Senate, in which are set forth Dr. Sherwood's "claims to have made new and important discoveries in magnetism generally, and more particularly in the magnetism of the earth; and to be the inventor of an instrument called the geometer, whereby, without the aid of the quadrant or sextant, or chronometer, and without taking a celestial observation, it is practicable and easy, at sea and on land, and in all weathers, to determine, merely by the dip of the needle, the variation of the needle, and the latitude and longitude of any place on the surface of the globe."

Dr. Patterson called the attention of the Society to some further extracts from the Report of the Naval Committee, in which it is stated that from the opinions obtained from scientific men, "as well as from their own examination, they are fully persuaded that the discoveries and invention of Dr. Sherwood are entitled to the most serious consideration of the public, and to the encouragement and patronage of Congress;" that they "regard them as highly interesting and important to the navigation and commerce of the United States, and as bidding fair to open a new era in the history of the science of magnetism." Of this Report 5000 additional copies were ordered to be printed by Congress.

Dr. Patterson remarked that the imposing circumstances under which

Dr. Sherwood's extraordinary claims were brought forward, might make a brief review of them worthy of the Society's attention.

1. The first of Dr. Sherwood's asserted discoveries is the communication of magnetism to a steel plate or ring, which he supposes others had failed to do. Dr. Patterson observed that, on the contrary, nothing is better known in experimental science than that magnetic polarity can be given to steel in any form, and with as many poles as the operator pleases. In illustration of this remark, he exhibited to the Society a steel plate, prepared some years ago by Mr. Saxton, who was then in London, according to an experiment first made by Chladni, on which polar lines were traced, so as to mark on one side the word '*magnet*,' and on the other the date '*24th of February*, 1836;' the position of the lines being made apparent by strewing steel filings over the plate.

2. Dr. Sherwood asserts that, if a steel ring, marked in two opposite points, have magnetism communicated to it by passing it over a magnet from one of those points to the other, in a way which he describes, the magnetic poles will be found to reside, not in the marked points which he styles the poles of the ring, but in other points distant from them 23° 28′, thus exhibiting a correspondence with the obliquity of the ecliptic. On this fact he founds his theory of the magnetism of the earth. Dr. Patterson mentioned that Mr. Saxton and himself had carefully repeated this experiment, and had found, without surprise, that the assertion of Dr. Sherwood was entirely erroneous. When the magnetism was communicated in the awkward manner used by Dr. Sherwood, the poles were not indeed at the points of the first and last contact of the magnet; but the deviation was irregular, was different at the different poles, and bore no relation to the obliquity of the ecliptic. When the magnetism was communicated to the ring by carefully setting two opposite points on the poles of a horse-shoe magnet, the *magnetic* poles of the ring coincided exactly with those points. This fact was shown in an experiment made before the society.

3. As to the hypothetical deductions of Dr. Sherwood, "that the magnetic poles of the earth are 23° 28′ from its poles, and of course within the polar circles," "that the magnetic and polar axes cross each other at the same angle of 23° 28′," "that the magnetic and terrestrial meridians of every place cross each other at angles dependent on the angles of the two axes," and "that the line of no variation is a great circle of the earth, and is that magnetic meridian, which, after cutting the magnetic pole, passes at the distance of 6° 28′ from the pole of the earth,"—Dr. Patterson remarked that these notions were directly contradicted by well-observed facts, that there are more than two magnetic poles, that the magnetic poles are not in the polar circles, that there are several lines of no variation, and that those lines are not great circles, but are altogether irregular in their course.

4. The practical applications of Dr. Sherwood's theory are announced in these terms: "With the correct dip given him, observed at a given time, he works out all or either of the following results: the variation of the needle, the distance of the circle of no variation from the place, and its angle with the meridian, and the latitude and the longitude. With the variation given him, in the same manner, he determines the dip and the other results. He must know, however, if the dip be given, whether the place of observation is east or west of the circle of no variation; and if the variation be given, whether it is north or south of the magnetic equator, and near the arctic or antartic semi-circle of no variation."

It is sufficient to remark, said Dr. Patterson, on this train of assertions, that they necessarily assume the truth, within the limits which are stated, of two positions: 1st. that the same dip will always correspond with the same variation, and 2d, that every place on the earth's surface has a different dip from all others,—both of which are notoriously untrue. The various examples, contained in the Report, of calculations made from the single datum of the dip or the variation, and which give for results all the other particulars with an accuracy extending not to seconds merely, but to thirds, must be regarded as illusory.

Mr. Walker also made a verbal communication on the subject of Dr. Sherwood's alleged discoveries. He remarked that even admitting the correctness of the Doctor's hypothesis, as stated in his Memorial to Congress, still his method would be of no use for nautical or geographical purposes, for the following reasons:—

1. The apparatus for determining the dip and variation of the compass is more costly than a common sextant and mercurial horizon.

2. The observations of the dip and variation of the compass are more difficult to be made with accuracy than a common lunar observation.

3. The reduction of these magnetic observations, on the Doctor's hypothesis, would be more laborious than the working of a lunar observation.

4. Mr. Walker proceeded to show, in conformity with the remarks of Dr. Patterson, that Dr. Sherwood's assertion that he can determine the latitude and longitude from the dip alone, or from the variation alone, was contrary to the first principles of the geometry of position; since a point, in order to be determined in space, must be referred to three given surfaces. If one of them is the surface of a spheriod as in geography, then the point must be referred to two other given surfaces; whereas by the dip alone, or the variation of the compass alone, a point can only be referred to one of these two surfaces, and the resulting locus is a line and not a point. Hence, if latitude and longitude are determined by magnetic observations, it must be by both the dip and variation. Dr. Sherwood's method, therefore, could be of no use for *nautical purposes*, from the impossibility of observing the variation of the compass at sea with any tolerable degree of accuracy.

5. Dr. Sherwood's assertion that the magnetic method could be used in cloudy weather is inaccurate; since the variation of the compass cannot be ascertained without astronomical observations.

6. Restricting then the use of magnetic observations to those made on land in fair weather, still, owing to local perturbations, the probable discrepancy of the mean of many observations at one place from the theoretic dip and variation, may, at a low estimate, be assumed to be ten minutes of space, and, as the resulting errors of *latitude* are of the same order, we shall have ten miles for its probable error, which is *twenty times* that of a common sextant and mercurial horizon.

7. Owing to the proximity of the north pole to Dr. Sherwood's assumed magnetic pole, the probable error in the resulting *longitude* would far exceed that of the dip and variation themselves, and would amount to *forty* miles on the average, and between the tropics, near the line of greatest variation, to *several degrees;* whereas it is well known that by the lunar method, the probable error in longitude is less than *six* miles, and may be reduced to *four* by means of half a dozen observed eclipses of Jupiter's first satellite.

Mr. Walker concluded by remarking that although, in stating the practical objections to the method, he had taken Dr. Sherwood's postulates for granted, yet he considered every one of them as contrary to facts, observation and experience.

Progress of Civil Engineering.

Early Progress of Railways.

The following historical sketch of the progress of the railway principle, is extracted from the last number of *Fraser's Magazine:*—

"Among the proofs constantly brought forward by those who assert that the ancients were merely children in science, we have frequently seen allusion made to railroads. And yet this vaunted discovery of the younger children of Time seems to have been known to their elder brothers. At least we find Æschylus speaking, in the *Eumenides*, of a road from Athens to Delphi; which, to use his own words, Κελευθοποιοι παιδες Ηφαιστου, 'the road-making sons of Vulcan,' (the god of blacksmiths) constructed, χθονα Ανημερον πριν, θεντες ημερωμενην, 'converting a country previously wild into a civilised one,' and thus producing the very results to which Lord Brougham and his school are constantly pointing, as the beneficial consequences of the rail-road system. To what extent this principle was carried in other parts of Greece, we know not; but in a mountainous country, where there was no lack of ironstone, nor of the means of converting the ore into bars of iron, it is probable that other roads were constructed of a similar kind. Yet so little notice has been taken of them, that, but for the accidental preservation of the *Eumenides*, we should have been unable to understand the language of Herodotus. That historian, speaking of the sacred road from the sea-coast to Heliopolis in Egypt, says that it was 1515 stadia long, and exceeded by 15 stadia the one which led from the temple of the twelve gods in the forum at Athens to the temple of Jupiter, on Mount Olympus. But, whatever may have been the knowledge of the ancients respecting the principle of an iron railroad, it does not appear that they applied it to the increase of the wealth of a nation—the only thing valuable in the eyes of a Baconian worshipper of Mammon. They were content, it seems, to devote their energies to making an easier road to the temples of their faith; we, to the marts of commerce: and unless London, Birmingham, Manchester, and Liverpool, be brought within a ride of twenty-four hours, the political economists tell us that the work of the Creator has been only the job of a bungler, and that till we can fly along a railroad with the velocity of a pigeon through the air, we must be, and deserve to be, hooted at by other nations, as the silliest of bipeds without feathers.

"With regard to the principle by which heavy bodies are rolled along a smooth and level road, it appears to have been put in practice at the siege of Constantinople, when Mahomet conveyed eighty light galleys and brigantines from the Bosphorus into the shallow water of the harbour, by constructing a level way, which was covered by a broad platform of strong and solid planks, rendered slippery by the application of tal-

low; and on which were drawn the vessels moving on rollers, just as masses of stone are now-a-days into the mason's yard.

"At the commencement of the seventeenth century, coals were conveyed from the mouth of the pit to the place of consumption in carts, and even in panniers on horseback, or, as we have seen them, some twenty-five years ago, in the neighbourhood of Ashby de la Zouch, on the back of the more humble, though not less Homeric, ass. But, as roads were not then, as they now are—thanks to the genius of a Macadam!—as hard as a diamond and as level as a die, they were soon cut up by the coal-carts, and in wet weather were nearly impassable. To remedy this inconvenience, *tram* roads were first constructed near Newcastle-upon-Tyne, about 1676. They were probably suggested by the unsuccessful experiments made by a Mr. Beaumont in 1646; who, after trying some plans for the better working of coal mines, and in conveying the coals in carriages of a novel construction, was ruined, like Middleton, the originator of the New River; and as Watt would have been, in all probability, had he not met with a powerful backer in his partner, Bolton. These tramroads consisted originally of wooden rails laid along the ground, made previously as level as possible. Upon these a machine, resembling a large box upon wooden rollers, and made to fit the rails, superseded the cart. The advantage gained by this simple contrivance was nearly thirty per cent. The regular load of a horse had been 17 cwt. previously; but he was enabled to draw upon the tramroad nearly 24 cwt. As the knowledge of mechanics became more generally diffused, and the doctrine of political economy, that time is money, more universally felt, various improvements were introduced in the construction of the wagons and rails. Amongst these is to be noticed the substitution of iron wheels for the wooden rollers of the wagon, and the adoption of cast iron rails, which were formed with a *flanch*, or upright ledge, to prevent the wheels from running off the track. The precise date of this change is not known. Several persons have laid claim to the invention; but from the books of the Colebrook-dale Iron Works, in Shropshire, it appears that some iron rails of that form were cast there for one of the partners, as an experiment, in 1767. It was found, however, that the flat rail, from its low position, accumulated extraneous matter, which formed a serious obstruction to the wheels. Hence the principle of the edge rail was adopted, which was fixed a few inches above the ground; and the flanch, to secure the wheel on the track, was transferred to the wheels of the wagon.

"Owing to the construction of the carriages, the horse (the only power then known) was unable to check the velocity resulting from the gravity of a descending body. Hence it was usual to detach the horse, and make him follow the wagon—a plan that led at once to the formation of a road upon a gradually descending plane, where the horse was required only upon the level portions of the line, and for drawing up the empty wagons to the summit of the ascent. But it was soon discovered that a check was requisite to impede the velocity of the descent. Accordingly, a break was introduced, acting by pressure upon the fore and hind wheels simultaneously; and which, being attached to a lever, was regulated by the attendant according to the speed at which he wished the wagon to descend. The action of the break was, however, irregular; for the rails were affected by the changes of the atmosphere, and especially in wet weather, when the wheels slid rather than revolved, from the want of a retarding rough surface.

"The next step was to dismiss the horse entirely, and to construct the road with two inclines, so that a descending train of loaded wagons might draw up an empty train, by means of a rope passing over a pulley at the top of the inclines, having its separate ends attached to the two trains. But, as the power of the loaded train was frequently too great for the weight it was required to draw up, a jerk was produced so as to snap the rope, or to cause the ascending train to bound off the rails; while, on other occasions, the power of the descending loaded train was insufficient to raise the requisite number of empty wagons. To meet the first difficulty, the friction was increased by the construction of multiplied wheels and pulleys; and to obviate the latter, a horse was employed to assist the power of the descending train.

"Here, then, from the operation of conflicting disadvantages, the rail road would have been at a stand-still, but for the discovery of the steam engine—that monster of human creation, which has more than realised the story of the hundred armed Briareus; and of which it has been said, there is nothing too great for it, nothing too small. Like the proboscis of the elephant, it can tear up an oak, or pick up a pin; can forge the heaviest anchor, and punch the eye of the finest needle; can twist the largest cable, or draw out a thread as delicate as the gossamer; can bore a cannon of the largest calibre, or form the shank of the smallest button; can drag a first-rate man-of-war against wind and wave, or flatten a mass of copper till it is as thin as gold-leaf.

"About 1760, and coeval with the introduction of iron rails (first adopted, it seems, by Mr. Carr, at the Sheffield Colliery), James Watt entertained the idea of employing steam as a moving power. But the design was speedily abandoned; nor was it until 1802 that the attention of engineers was again directed to locomotive engines* upon rail roads; when a patent was taken out, and the principle tested successfully at Merthyr Tydvil, in South Wales. But here again an obstacle presented itself, which has been only partially overcome, in the tendency which iron wheels have, when passing over a smooth surface, to turn round without progressing, and especially upon an ascent. To meet this difficulty, Mr. Blenkinsop invented a rack, continued along the whole distance of the rail, in which toothed wheels worked, and thus produced a progressive motion. Messrs. Chapman, however, adopted a chain, which was stretched along the centre of the railway; and being grasped by a grooved wheel and roller, at each stroke of the engine it was impelled forwards. Mr. Brunton invented two movable iron legs, each jointed, and terminating in a claw. These were placed behind the engine; and being acted upon by the piston, fixed themselves alternately in the ground, and drove the engine forward at each stroke. But as all such expedients only increased the friction, and diminished the power of the engine, they were eventually laid aside; especially after M. Blacket had proved, in 1815, that the wheels would progress on a railway, either level or with a slight rise, if the weight to be drawn was in a certain ratio to the moving power." Mining Journal.

* Towards the end of the last century, one Oliver Evans, of Pennsylvania, is said to have invented a steam engine, with which he first ground his flour, and, after placing it on a carriage, drove it to market; but, as he had a river to cross, he substituted paddle wheels for those of the carriage, which was made like a boat, and, after crossing, he unshipped the paddles and resumed the wheels. This account, which is to be found in the "Foreign Quarterly Review," is, we suspect, a history rather of what Evans said he would do, than of what he actually accomplished.

Asphaltic Mine in Pyrimont.

The following is an account of a very curious phenomenon, which has given rise to a production of the highest importance to the arts; I mean, the mine of asphalte of Pyrimont, situated at the foot of the eastern side of Mount Jura, on the right bank of the river Rhone, and one league north of Seyssel. In that locality, the surface of the ground is covered by molasse (siliceous gravel and bitumen), which extends from the banks of the river to the foot of the mountains, covering the last strata of the superior calcareous oolite, of which these mountains are composed. The molasse is intercepted by deep ravines, in which may sometimes be seen the "calcaire inférieur," which is frequently cretaceous, and belongs to the preceding oolitic formation.

At Pyrimont, a mass of calcareous asphalte, situated between two ravines, rises from the middle of the molasse on a surface of 800 metres long by 300 metres broad. This calcareous matter, the exterior surface of which is whitish, is internally of a deep brown colour, due to a certain quantity of asphalte with which it is saturated. The asphalte is, for the most part, equally diffused throughout the rock, yet some parts may be seen more or less saturated, and others in which the calcareous matter is quite pure; the disposition of the latter, would lead to the conclusion that the asphalte is ramified in veins in the calcareous mass buried under the molasse. The calcareous asphalte is not stratified; fissures are seen, which intersect each other in all directions, and divide it into irregular blocks.

In the surrounding molasse, the bitumen has penetrated in large veins; and in the excavation of this material, galleries have been formed, which follow their various sinuosities. The molasse is also impregnated with bitumen, absolutely in the same way as the calcareous substance, and as it is more porous, the quantity of bitumen is greater.

The rock which covers the calcareous asphalte, prevents the tracing of it to its junction with that which constitutes or composes the mountain, at the foot of which it is situated, and conceals the extent to which the calcareous mass is impregnated with bitumen. But in the same mountain, above Dorche and near Sauthonod, in the Val-Romey, is to be found calcareous schistose, also impregnated with bitumen, inserted between the layers of the corallien group. According to M. Millet, the bituminous schist contains impressions of vegetable remains, which are found also in the calcareous schistose that are not bituminous, of the same group. This fact proves that the bituminous matter, whatever may be its origin, has spread itself from the interior of the Val-Romey, to the banks of the river Rhone, passing through the rocks which it met in its passage at different epochs, and in different ways.

Our colleague, M. Millet, of Aubanton, who made the analysis of those bituminous rocks, of which we have just been speaking, has arrived at the following results:

1st.—The calcareous asphalte of Pyrimont, contains from 9 to 10 per cent. of bitumen, the remainder is carbonate of lime, nearly pure.

2d.—The bituminous molasse contains as much as 15 or 18 per cent. of bitumen, the remainder is micaceous sand, exactly resembling that which composes the molasse.

3d. The bitumen extracted from the two rocks, is identically the same. Tried with sulphuric ether, it gives a yellowish substance, which

burns with flame and smoke; it is soluble in essential oils, and insoluble in acids. By distillation, the oil of petroleum is obtained in very small quantities; acetic acid is formed in the operation; the residue is brittle, and fusible at a high temperature. The part which the ether does not act upon appears to be carbon; this, when heated in the air, burns with little or no remainder.

From these results, M. Millet concludes that bitumen is a compound—

1st. Of resinous petroliferous matter, ...	60 to 70
2d. Of carbon	30 to 35

Which would give the proportion of one to two between the resinous matter and carbon, a proportion which our colleague has found to be the same in all the analyses he has made. A great number of observations induces him to believe, that it is from the carbon that the black colour of the bitumen and its property of hardening in the air arises, which renders it so useful in the arts.

The bituminous matter being found both in the calcareous rock, and the molasse with which it is covered, it is evident that the action of the cause which has introduced it into these two rocks, succeeded the deposit of the latter; the way it is distributed in large masses, casting ramifications in various directions, and the superior parts generally containing less bitumen than the rest of the mass, shows that the bitumen has been sublimated or refined from the depth of the globe, through a fissure corresponding with the direction in which it is now observed; and that it condensed itself in the superior rocks, the heat having dilated or expanded the pores, which, by contracting themselves in cooling, might have rendered the combination as close as now seen. The nature of bituminous rocks (molasse, calcaire-crétacé, et schiste-calcaire) adapt themselves to this kind of action. The molasse and the calcareous rock are so porous, that they readily imbibe water; the calcareous schist also adheres to the tongue. It is therefore probable, that these rocks have easily been penetrated by the bituminous vapours, which most likely spread themselves over all the three at the same time.

The epoch of the introduction of the bitumen into the preceding rocks being necessarily of a subsequent date to the deposit of the molasse, one may presume that it corresponds to that of the basaltic eruptions, which, it is clearly proved, by several facts, have often been accompanied with bituminous substances: it is at the same epoch that the Alps and Mount Jura must have experienced the last commotion which has changed their form, by breaking the rocks, whose fragments, at this day, compose those enormous masses, which are covered over only by the deposits of the present era. It may be objected, that no basaltic rock is to be seen in the whole range of the mountains of Jura. To that I reply, that some are to be found in its neighbourhood, in Burgogne and in the Vosges; besides, it must be observed, that in order to cause changes on the surface of the ground, either by fractures, or by the disengagement of vapours, it is not necessary that the plutonic rocks should appear outwardly. It may happen, that in the bottom of the valleys of Jura, the basaltes are at a small depth.

The phenomenon of rocks impregnated with asphalte, is not confined in Mount Jura to those localities we have just quoted; many are also to be found in several other places on the eastern side, and particularly in the Val-Travers, near Neufchatel, but they are not so well developed as

in the neighborhood of Seyssel, nor have they acquired the same importance in the arts.

I have seen in the possession of M. Brongniart, specimens of the calcareous asphalte of Val-Travers; it resembles very much that of Pyrimont, and a fragment, of which a very small portion is impregnated, has shown me again, that it was the porous calcaire of the corallien group.

The calcareous asphalte of Pyrimont is seen on the surface of the ground, in a space circumscribed by the molasse, of 800 metres in length and 300 metres in breadth. The thickness of the mass has not yet been ascertained, but it appears to be considerable. The mass is openly worked, large blocks are extracted, which are afterwards broken to pieces.

The bituminous molasse is worked by galaries following the sinuosities of the veins: when carried to the (usine) depôt, it is broken into pieces of the size of an egg, which is refined with boiling water, to extract the bitumen from it.

The calcareous asphalte is reduced to powder, that it may be more easily mixed with the bitumen.

In the preparation of the mastic, ninety-three parts of calcareous asphalte is mixed with seven parts of bitumen, extracted from the molasse; the whole is exposed in furnaces or cauldrons, for a long time, to the action of fire; when quite fluid, it is poured into moulds of any shape that may be required, to render it portable. Many attempts have been made to imitate the mastic of Seyssel; and as a substitute for the calcareous asphalte, they have employed other substances, which absorbing from 40 to 50 per cent. of bitumen, gives a composition which the heat of the sun melts, and which, when exposed to cold, cracks. And in some cases, they have employed substances, which having no affinity whatever for bitumen separated by time.

The genuine mastic, which is melted on the spot where it is used, in a few instants after it is poured into the mould, becomes so very hard, that at a temperature of more than 30° Reaumur, = 100 Fahrenheit, it will receive no impression, yet it retains a certain degree of elasticity, whereby it adapts itself (or stretches) without breaking, to all the motions which the masonry, or roof, &c., where it is applied, undergoes.

The mastic of asphalte is employed for covering terraces, roofs of buildings, footpaths of bridges and streets, arches, cellars, and interior areas, &c.; also in the construction of aqueducts, basins, and all kinds of hydraulic works. It has been used to cement stones, bricks, and even metals.

Many works have been executed in Paris and its environs, with the mastic of Seyssel; for instance, the footpath on the Pont Royal, and that of the Louvre; trials which have so well succeeded, that the authorities of the city have decided to adopt the same materials for the footpaths of the streets, also of the Place de la Concorde (formerly called Place Louis XV.) which is about to be laid out on an extensive and grand scale.

The magazine of provision at Bercy, has been covered for upwards of a year with this mastic, and succeeds perfectly.

In the years 1832, 33, 34, this mastic was, with equal success, employed in the construction of the military works at Vincennes.

It has also been successfully employed in the military constructions at Douai, Besancon, Bourbonne-les-Bains, Grenoble, and Lyons. In the

last city, all the covering of roofs and the interior areas of the new forts have been constructed with it.

More than forty years ago, at Fort l'Ecluse, a small building was covered with this mastic, which has ever since continued in a perfect state of repair.

The asphaltic mastic, the nature of which now begins to be generally understood, will render peculiar advantages in architectural constructions.

The working of the asphaltic rocks of Pyrimont, is traced back as far as 1790, but whether the product has been little known, or whether from ignorance of its application, the mine remained in a state of stagnation till the year 1818, from which time to 1820, the annual sale rose to 200,000 kilograms. The improper application of the mastic, together with the want of sufficient capital on the part of the company who were working the mine, retarded their operations; but for the last six years, the owner, the Count de Sassanay, who resides on the spot part of the year, having devoted his attention to the subject, the working of the mines has increased to a great extent. In the year 1835, the sale of the mastic exceeded a million of kilograms, and bids fair for a continued increase.

Count de Sassanay has constructed at Pyrimont a very elegant place for the preparation of the asphaltic mastic, and devotes the whole of his attention to the perfection of the process employed in its manufacture. The importance which the use of this material of Seyssel will give to the constructions at Paris, must justify in the eyes of the society, the details into which I have entered, with regard to that substance.

Mining Rev.

On Iron best suited for Railways; by David Mushet.

The following conclusions at which I have arrived on the important subject of the nature and habitudes of malleable iron, particularly that adapted to railway purposes, are the result of many experiments, and of forty years unremitted application to iron making.

1st. I consider that a crystalline arrangement of the fracture of bar iron is incompatible with great strength and fibre, and that it is essential to railway iron that it should be hard and fibrous.

2nd. The more frequently iron is heated or melted in the course of its progress towards its completion as bar iron, the greater is its tendency to crystallize and become brittle when cold. This is in some measure prevented by repeated rollings; but fibre acquired in this way is to a certain extent artificial, for where native fibre is absent, heating and cooling will restore the crystalline arrangement and weaken the tenacity of the iron when cold.

3rd. Excessive decarbonization, commonly called refining, which tends to deprive the iron of its last portion of carbon, produces a quality of malleable iron, soft, and easily abraded by rubbing or friction, and therefore, in point of durability, not well calculated for rail iron.

4th. Conversely, iron manufactured so as to retain the last, and consequently, the most intimately united portions of carbon, or to have this substance communicated to it in minute portions in working, is upon two accounts better calculated for rail-making (provided the fibre

is not injured) because it will wear less by rubbing, and be subject to less waste by oxydation.

5th. Bar or malleable iron has a tendency to crystallize in the cooling, in proportion to the size of the manufactured mass, a circumstance deserving the greatest consideration on the part of the engineer in determining the form or shape of his rails.

6th. Continued vibration, such as is produced by the motion of an engine or wagon traveling on a railway, causes iron to crystallize, and to a certain degree become brittle. Hence the importance of making rails from iron full of fibre, so as to postpone the time of crystallization to as remote a period as possible.

7th. Unless impaired or destroyed, by the repeated heatings and fusions to which iron is subjected in the progress of its manufacture, the quantity and strength of fibre developed, will mainly depend upon the proportion of carbonaceous matter, originally contained in the pig-iron from which it is manufactured.

8th. It is essential in rail making, to have a quality of iron, which, without dropping or opening at the rolls, will stand a degree of heat capable of compactly and adhesively welding the piles together so as to prevent exfoliation or separation of the parts when subjected to railroad traffic.

Considering the foregoing conclusions to be well founded, it has often been to me a matter of surprise, that the two most important qualities of iron for rails, namely, fibre and hardness, have seldom or never formed a condition in any railway contracts for rails. Certain manipulations or stages of operations, which may be necessary in making iron for smiths, or indeed for general purposes, are usually stipulated for without its being taken into the account, that the properties required in railway iron may be quite the reverse. The consequence of this oversight, has been to withdraw the attention of the manufacturer from these important desiderata, and induce him to follow the letter of the engineer's specification as to process, leaving the properties of fibre and hardness to the chapter of accidents.

The present process of bar iron making, is in some measure incompatible with the production of the above mentioned requisites for railway iron, and this may serve to account for the difficulty of obtaining fibrous masses, such as rails of 60 to 75 lbs. per yard, as well as for the want of hardness in the body of the rail itself. The whole process is one of severe decarbonization. The pig iron for the refinery is in most situations chosen with as small a portion of carbon as will enable it to melt. In this furnace, in order to separate about 4 per cent. of carbon, manganese, silica, &c., from 12 to 15 per cent. of the whole quantity of iron is lost, by being converted into a slag or scoria of a most deleterious quality. After the pig iron has, by melting, passed under the blast, and penetrated the body of cinder, it is then literally set on fire by the action of the blast pipes on its surface, and the decarbonization is carried on, not by fermentation as in puddling, but by a true combustion of a part of the iron, and by a change of surface produced by an alteration in the specific gravity of the particles of the iron. Should the quantity of refinement have been limited, the new arrangement resulting from the fusion of the iron, in so high a temperature, will be found unfavourable to fibre in the ultimate result. So, that to produce any certainty in this respect, it becomes necessary to prolong the refinement

until a new and steelly arrangement takes place, and this arrangement of the iron in running from the furnace, is indicated by the extreme levity, intense combustion, greater waste, and a porous, or honey-comb, fracture of the metal when cold.

This commixture of crude iron and steel, is again melted by flame in the puddling furnace, where it undergoes, by the addition of cinder, a process of fermentation, which carries off the last portion of carbonaceous matter, and leaves the iron comparatively soft when cold.

The reverse of this takes place in the manufacture of charcoal iron. In this operation, the pig iron, during the single process which converts it into malleable iron, is always in contact with fuel. This prevents that total decarbonization which takes place with puddled iron that has passed through the refinery. Hence the superior hardness and tendency towards steel in Swedish and Russian iron.

To the subject of fibre, my attention has for some years been directed. At various times I have made numerous experiments, and it has been gratifying to find, that the same means employed to obtain fibre, to a certainty produced a superior degree of hardness and durability, and altogether avoided the process and waste of the refinery. In the method I have adopted (and for which I have lately taken out a patent) the charge of pig iron is at once introduced into the puddling furnace, where it is subjected to an imperfect, though uniform, fusion, the temperature being no more than is barely necessary to melt it. In this state a portion of finely ground rich iron ore, as a substitute for cinder, is from time to time thrown upon the iron and worked into it by the puddler. In a short time considerable fermentation takes place, and gas is evolved. In twelve or fifteen minutes pig iron of the most crude and fusible description, is converted into malleable iron, which appears in a flakey and divided state. The heat being increased, the iron coaleses and is formed by the puddler into what are called balls of puddled iron. These are, in the usual way, taken to the hammer or rolls, and elongated into bars called No. 1, or puddled bars. These again are cut into certain lengths, piled upon each other and re-heated, and for the purpose of railway iron rolled into broad bars or slabs, known by the name of No. 2 iron. These in their turn, are either piled alone a second time, or mixed with narrower iron, re-heated and rolled into rails in that state, which is called No. 3 or best iron.

The quantity of iron ore required to decarbonate the pig iron, depends upon the fusibility of the latter, and varies from one-tenth to one-twentieth the weight of pig iron; and the fusibility principally depends on the quantity of carbonaceous matter contained in the iron, which is as various as the numerous shades between white iron and dark grey foundry iron.

By following this process a considerable saving of pig iron is effected at a very trifling increase of expense for ore, and additional labour beyond the expense of the usual mode of working. This is one great advantage of the process, but the most important consists in being able at all times to develop, in the first stage of the manufacture, a certain quantity of strong fibre, which is increased during the ulterior operations, and conjoined with great hardness.

Iron ore when used in the puddling furnace, whether with pig iron or with refined metal, decarbonates the iron by means of oxygen which it presents to the carbon united with the iron, and at the same time it calls

into existence an unusual display of fibre. This remark applies as well to refined metal as to pig iron, and no degree of fusibility on the part of the pig iron retards the full and beneficial effect of the iron ore, provided it be applied in proper quantity.

I consider pig iron, and not refined metal, as the true source of strength, hardness, and fibre in bar iron, particularly when cold, and as these qualities can at all times be obtained by a judicious selection of pig iron, and the use of iron ore, we may consider ourselves in possession of a method by which these three great requisites to the production of railway iron are secured. I have only further to remark, that it is probable the piling and rolling in the first instance may be done away with in the making of railway iron, by hammering the puddled balls into large and solid blooms, to be afterwards rolled into rails. By following this line of operation, the great evil of lamination, as it is called, or a separation of the piles, hitherto so injurious to durability, would be got rid of. Lond. Mech. Mag.

On Captain Huddart's Improvements in Rope Machinery. By W. Cotton.

The attention of the late Captain Huddart was directed to the subject of rope-making, from observing every morning during a voyage, that some of the external yarns of a ship's cable were broken.

This was evidently to be attributed to the additional strain which the outer yarns experienced in the process of twisting, the yarns being all originally of the same length. It was proposed to obviate this defect by giving to all the yarns an increased length in proportion to the distance of the yarn from the centre of the strand, and to the angle at which it was laid. The success which attended these efforts induced Captain Huddart to construct the large laying machine, which was found to answer completely, and to give each strand its proper length and proper degree of twist, and to preserve throughout the longest rope the same press and the same angle.

The paper contains some historical notices respecting the establishment of the extensive works of Huddart and Co., at Limehouse, and the various stages of improvement. Several pieces of strand, to illustrate the foregoing principles, were presented, as also a piece of the twenty-two-inch cable made for the East India Company's ship Waterloo; a strand of the long rope made for the London and Birmingham Railway; and some cards containing the comparative strength of the warm and cold, registered and common, cordage.

The distinguished individual of whose improvements in rope machinery a brief account has been here given, was born at Allenby, in Cumberland, in 1741, and died in 1816, after a life devoted to the pursuit of those scientific researches for which his rare talents so eminently qualified him.

In the strands, as constructed on this principle, the strain on all the yarns will be the same so long as the original degree of twist is preserved; but if the strand becomes untwisted, there is an extra strain on the internal yarns; if more tightly twisted, on the external yarns; several strands, however, being worked together in a cable, the twisting or untwisting of each particular one is prevented. Trans. Civil Engineers.

Note on foundations upon sand; and on coatings of mineral tar: by M. Olivier, *engineer of Roads and Bridges.*

Translated for the Journal of Franklin Institute, by J. Griscom.

1. *Foundations on Sand.* At the school *des Ponts et Chaussées,* in 1830, it had been pointed out to us, that foundations on sand might be laid, wherever the earth was compressible, and in no danger of being carried away by floods. The canal of Saint Martin was given as an example. I have several times applied the system thus indicated and always with success. The following are examples: M. Dupuis, one of the conductors in my district, an architect of the town of Pont-Audemer, was employed to erect a building for the mayoralty. Its situation required that the edifice should be founded on the natural soil. This was well, for there is, in the valley of the Rille, a little below the soil, a bed of solid stones, mixed with sand, of about 31½ inches thick. M. Dupuis, feared that the ground under the bed of gravel was not good, and he had it sounded. It proved to be compressible, and when the gravel was removed, it became impossible to lay a good foundation on the earth which it covered. The architect deemed it needful, in consequence, to resort to piles, and these, it was ascertained, must be very long to reach solid ground. I went to see the work as they were beginning to drive the piles: it was a very expensive undertaking, which I proposed they should avoid, by substituting a bed of water sand, well watered with cream of lime. M. Dupuis, being responsible for the work, could not decide upon taking this advice, and continued the piles sufficiently for the whole front wall; but he adopted for the other walls the plan I had recommended. These were all, of course, united, though resting on different foundations, but they have all remained firm without any movement, or at least it has been uniform.

This furnishes a new proof of the safety of foundations on sand; 1st, since all the erections in the valley of the Rille, founded on the bed of gravel before mentioned, stand very well, though the ground underneath is compressible; 2nd, since the walls placed on sand, resting on soft ground, have not sunk more than those built on piles, driven with the greatest care to a solid foundation.

Another fact. M. Fauquet Lemaitre, is a proprietor, at Bolbec of several cotton factories. One of them being burnt down, he extended the other, which made it necessary to connect the new with the old walls: these walls, situated at the foot of a hill, were partly on a mass of chalk and partly on a bottom of green sand, in spaces where no chalk existed. This sand was moistened by infiltrations of water, which could not however wash it away. When a weight was placed on this sand and left at rest, the mass remained firm; but if a little motion were given it, it became pasty and almost liquid. The builder thought he must have recourse to piles, and several foundations were prepared for their being driven, when M. Fauquet spoke to me about his buildings, and of the position in which he found himself. At this time, the experiment before cited had been made, and I advised him to lay his foundations on sand. I requested him to converse with M. Frissard, chief engineer at the Port of Havre, and he did so. The latter coincided with me, and added that all the masonry of the steam engine of 60 horse power, was founded on sand, and nothing had moved it. It was not so with the struc-

tures on piles; a side wall, connected with the foundationof the engine, placed on piles driven as deep as possible, had moved so much that the connecting stones were broken, so that they had to saw them off from the engine walls, the level of which had not changed. This accident, it was believed, occurred from the water contained in the sand, having collected more abundantly around the piles; and the friction of the latter against the ground, being thus diminished, they sunk until the masonry rested on the sand.

As other walls erected on sand or on rocks, have not moved, this experiment proves that foundations on sand are as safe as those on rocks, while we cannot rely upon the stability of an edifice constructed on piles and driven into sand; the friction which they encounter induces the belief that they have gone as far as possible, or necessary, and when any cause diminishing this resistance from friction occurs, an accident follows which proves the contrary.

The first experiment was made under my own eyes; the second I did not witness, but have every reason to believe that a true account was given me.

2. *Employment of mineral tar in structures of masonry.* It has for a long time appeared to me that mineral tar, which does so well upon wood and iron, might also be used for covering stone and brick work, as a defence against moisture. Four experiments were made which confirmed this apprehension. But it will be well to premise that as mineral tar is obtained by distilling vegetable materials, it would be more suitable to call it pyroligneous tar.

Without touching upon all the cases in which pyroligneous tar may be employed, which we believe to be very numerous, we shall simply cite a few in which we have tried it.

The light house of Quillebuef had become much degraded by North East storms. The rains were very copious, and the water passing into the brick tower, caused the bottom of the stair case to rot. We repaired the masonry, and in the month of May 1833, painted the tower with pyroligneous tar, which so far has perfectly answered our expectations; excepting that a few of the pilots pretend that the light house, being now black, is not seen so well as when it was white.

M. de Cachelu painted with the tar an earthen wall, exposed to the rains so much as to become very wet inside the building. When I saw these walls, the tar had served as a complete defence against the dampness.

Walls much exposed to storms of rain, are commonly defended by a coating of slate or cement, but the above experiments shew that these two modes of defence may be advantageously replaced by a coating of pyroligneous tar.

The joints of the wall being well filled up and smooth, the tar is spread over it and it penetrates the wall. When dry, a second coat is applied and immediately powdered over with sand. This, when solidified, is covered with lime white wash, as thick as can be put on with a brush. This, acting on the carbonic acid of the atmosphere, forms a crust of limestone which exists for a long time, and once in two or three years the wall may be re-white-washed.

We have employed this treatment on bridges very successfully.

In courts, and yards, and terraces, the tar coating is now employed with great advantage. When worn or broken it is easily repaired.

Annales des Ponts et Chaussées.

Mechanics' Register.

Progress of Railways in England.

In the course of three years, 1500 miles of railway will, in all probability, be executed in England alone, and, calculating the average cost, inclusive of engines, at 20,000*l* a mile, 30,000,000*l*. will have been spent in carrying them into execution. It is an unprecedented advance in the improvement of intercourse, and it is a plain speaking fact of the estimation in which this mode of travelling is held by the nation, both as an investment and as an improvement on the old system. England is not, however, the only country in which railways have made such rapid strides.

Lond. Mech. Mag.

Patent Furnace for Consuming Smoke.

On Friday, the 20th, inst., in Messrs. Vernon and Company's boiler works, was exhibited a most successful trial of a full-sized locomotive fire-box, constructed upon a plan for burning smoke, for which Mr. John Gray, of the Liverpool and Manchester Railway Works, has taken out a patent. We congratulate Mr. Gray upon having made such an important discovery, which must necessarily be a source of great profit to himself, as well as incalculable benefit to the public. We acknowledge that we had been rather sceptical on the subject of burning smoke, inasmuch as all the plans which we had previously seen in operation for this purpose, have been more or less liable to objections which have militated against their general practicability, but in this case there is nothing arising out of its construction in either expense, danger, or complexity, which can operate against its universal adoption, but on the contrary, the smoke was most completely consumed upon a simple, cheap, and safe plan. It is applicable either to locomotive, marine, or land boilers, and we have no hesitation in predicting that it will soon be in general use. Upon a fair calculation, it appears that the Liverpool and Manchester Railway Company, alone, may save by it upwards of 6000*l*. a year, by substituting coals for coke, which they are at present compelled to use in order to dispense with smoke. In marine or land boilers, the saving must also be enormous, by burning those dense clouds of smoke which, in ordinary cases, are suffered to escape at the chimney tops, thus rendering available the vast accumulation of carbon which it contains. Two locomotive engines are now in progress of being made by Messrs. Thomas Vernon and Co., with fire boxes upon this plan, which are intended to burn coals instead of coke, the success of which we deem quite certain.

Min. Journal.

***A method of breaking Ice by forcing it upwards instead of downwards; practised on the Herefordshire and Gloucestershire Canal in the Winters of* 1834, 1835 *and* 1836; by Stephen Ballard, A. Inst. C.E.**

Mr. B. places strong planks covered on their upper side with sheet

iron in the front of a boat, so as to form an inclined plane pointing downwards, the lower end of which goes under the ice. The boat, drawn by a horse, is steered by a person walking on the shore with a long shaft attached to a pole projecting over the stern. It is believed that one boat, horse, and boy, would thus break much more ice than three boats worked in the usual manner.

Journ. Arts and Sci.

Eye Shaped Windows.

The peculiarity of this place, and which kept us laughing at the recollection for nearly a mile after we left it, was the windows in the roofs of the houses. They are shaped exactly like eyes: the tiles swell up gradually like a lid above and below, elongating towards the end; and in the oval space between these twinkles the little bright window pane, just in the place of the pupil. It was, in fact, as exact a model of the human eye as could be made out of such materials. I never saw any thing so funny. The whole village had an *eveille* Argus-like look, that was irresistably droll; all the houses laughing, and blinking, and peeping at us as we drove in. The shape being long, and the lower lid rather straight, gave them a sly, sleepy, half closed expression, and, withal, a look of fun and merriment, as if the house were "holding its sides" with laughter. Sometimes we came to a great Cyclops building, with its one staring optic in the middle of the roof; and then appeared a comical intelligent looking thing, with a pair, that twinkled and screwed themselves up at us as we passed, in the most provoking and impertinent manner possible. It was really too bad. (*A Lady's Souvenirs of a Tour in Germany.*

Arch. Mag.

Frozen Ground of Siberia.

The whole of the Northern Siberia presents the singular phenomenon, that, even in the hottest season, the soil remains frozen from a certain depth downwards, differing according to the latitude, and other local circumstances, and that the thickness of this frozen stratum is so considerable in the more easterly places as for instance, at Jakutzk, that its bottom has not yet been reached. Gmelin relates that in the archives at Jakutzk, he found an account of an inhabitant of that town having, at the beginning of the last century, together with some Jakuters, contracted to sink a well, and that, when they had reached the depth of ninety feet, finding the earth still frozen, they refused to fulfil their engagement. Some philosophers have considered this contradictory to the supposition that the interior of the earth is in the state of fusion. But from the following account it will be seen that, in those frozen strata, the general phenomenon of an increase of temperature with the depth is not wanting, and that by continuing the work, they have arrived at a temperature which leaves no doubt that they are not far from the lower limits of the frozen soil, and that water, the object of their undertaking, is not far distant. An article from St. Petersburg, in the Berlin News of the 24th February, 1832, states that at Jakutzk,

in Siberia, the earth, even in the hottest summer, only thaws to about the depth of three feet. Hitherto all attempts to discover the thickness of the frozen strata beneath, have been fruitless. Since the year 1830, one of the inhabitants of Jakutzk has been engaged in sinking a well, by which means it may perhaps, be ascertained. In the same year the workmen reached the depth of seventy-eight feet below the surface, but still found no water. In the year 1831, they reached ninety feet, and were still in the frozen soil. The work is still in progress, and there seems no doubt of their attaining their object, for the thermometer, which showed 18 deg. 5 min., a few feet below the surface, rises, when sunk to the bottom of the well, to 29 deg. 75 min.—*Edin. Phil. Journ.*

Min. Jour.

Condensation of Moisture on Optic Glasses.

The condensation of moisture which is apt to take place upon the object glasses of telescopes in the atmosphere of the evening, may it is said, be obviated by the employment of a tube of pasteboard 12 or 18 inches in length, so constructed as to fit upon the object end of the instrument. The invention, is ascribed to the celebrated astronomer De la Hire.

Lond. Mech. Magazine.

LUNAR OCCULTATIONS FOR PHILADELPHIA, DECEMBER 1838.					Angles reckoned to the right or westward round the circle, as seen in an inverting telescope. ☞ For direct vision add 180° ☜	
Day.	H'r.	Min.	Star's name.	Mag.	from Moon's North point.	from Moon's Vertex.
2	16	14	Im. *c* Aurigue	6	102	162
2	17	18	Em.		233	293
4	9	24	N. App. ☽ & λ Cancri 6 ☽ S. 0.'3			
21	4	48	Im. 50 Aquarii	6	55	62
21	5	10	Em.		21	34
24	9	34	Im. ι Piscium	4	105	148
24	10	39	Em.		319	7
26	13	39	Im. 47 Arietis	6	152	206
26	14	18	Em.		237	290
27	7	24	N. App. ☽ & *b* Pleiadum, 4,5 ☽ S. 2.'2			
27	7	17	Im. *d* Pleiadum	5	119	70
27	8	38	Em.		293	267
27	8	25	Im. (151) Pleiadum	7	167	138
27	9	13	Em.		244	244
27	7	59	Im. η Tauri	3	124	85
27	9	17	Em		286	286
27	8	54	Im. *f* Pleiadum,	5	77	64
27	10	0	Em.		327	353
27	8	54	Im. *h* Pleiadum,	5, 6	94	81
27	10	11	Em.		309	341
30	16	32	Im. 47 Geminorum	6	86	145
30	17	31	Em.		238	295

Proposed mode of obviating the dangers which now exist in carrying on the works of that ill-fated undertaking, the Thames Tunnel.

Let a raft or deck, be constructed of massive timber, and caulked similar to a ship's deck; this raft must be 30 or 40 feet wider than the Tunnel, and sufficiently long to cover that part of the bed of the river immediately over the part of the Tunnel where operations are being carried on: by laying a sufficient weight upon the raft, it could be sunk and imbedded into the bottom of the river, so as to form, I think, a complete protection to the workmen underneath. The irruptions which have taken place proceed, I believe, from two causes; first, from the loose nature of the soil composing the bed of the river; and, secondly, from the immense pressure of the great body of water; the raft would undoubtedly counteract the evil of the pressure of water, and if sufficiently imbeded into the bottom of the river by heavy weights, would, I think, become sufficiently water-proof to enable the workmen to excavate to the bottom of the raft, if necessary, without the fear of inundation. When that part of the Tunnel was completed over which the raft was placed, it could be removed by the following simple means.

Let an iron ring be strongly inserted at each corner of the raft, at low water. Chains could be easily attached to these rings; then tightly moor a lighter to each chain; and as the tide rises, the raft would also rise, and could be easily lowered over that part of the Tunnel next in operation.

Lond. Mech. Mag.

Meteorological Observations for June, 1838.

Moon.	Days	Therm. Sun rise.	Therm. 2 P.M.	Barometer. Sun rise.	Barometer. 2 P.M.	Wind. Direction	Wind. Force.	Water fallen in rain.	State of the weather, and Remarks.
				Inch's	Inch's			Inches.	
	1	56	82	29.85	29. 5	SW.	Brisk.	.27	Clear—rain.
☾	2	62	76	80	85	W.	do		Partially cloudy—clear.
	3	52	78	80	80	W.S.	Moderate.		Clear—do.
	4	58	74	80	75	S.	do.	1.00	Fog—rain.
	5	62	73	40	40	NE.	do.	.95	Cloudy—rain
	6	60	67	44	44	N.E.	do		Partially cloudy—do. do.
	7	56	73	40	50	W.	Brisk.		Cloudy—clear.
	8	60	84	80	80	W.	do.		Clear—do.
☉	9	64	86	30.00	30.00	E.W.	Moderate.		Clear—do.
	10	56	88	00	00	W.	do.		Clear—do.
	11	68	88	29.95	29.95	W.	do		Clear—do.
	12	68	88	90	90	W.	Brisk.		Clear—do.
	13	70	90	86	86	W.	Moderate.		Clear—do.
	14	70	88	90	90	W.	do.		Clear—do.
	15	70	87	95	95	S.W.	Brisk		Clear—do.
☽	16	68	83	95	95	S.W.	do.		Clear—flying clouds.
	17	76	85	85	60	SW.	Moderate.		Cloudy—clear.
	18	60	85	60	60	N.E.	do.		Cloudy—do.
	19	58	70	30.00	30.00	N.E.	do.		Clear—do.
	20	50	77	5	5	E.	do.		Clear—do.
	21	61	80	29.95	29.95	S.W.	do.		Cloudy—clear.
	22	68	86	86	83	S.W.	do.		Clear—flying clouds.
⊗	23	68	91	80	80	S.W.	do		Clear—do.
	24	68	78	78	70	S.	Calm.!	1.20	Showery—heavy thunder—shs.
	25	68	80	70	70	S.W.	Moderate.	.28	Clear—rain.
	26	61	80	75	80	W.	Brisk.		Clear—do.
	27	63	80	96	96	N.W.S.W.	Mederate.		Clear—lightly cloudy.
	28	68	76	80	75	W.	do.	.03	Cloudy—showery.
	29	68	83	78	78	W.E.	do.		Clear—do.
	30	69	80	78	80	S.E.	do.	.28	Cloudy—showery.
	Mean	62.80	81.60	29.81	29.81			4 01	

	Thermometer.	Barometer.
Maximum height during the month.	91. on 23d.	30.05 on 20th.
Minimum " " "	50. on 20th.	29.40 on 5th, and 7th
Mean	72.20	29,81

// JOURNAL

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Practical and Theoretical Mechanics and Chemistry.

FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

On the liquefaction and solidification of Carbonic Acid.

By J. K. Mitchell, M. D.

In the year 1823 public attention was strongly drawn to the subject of the liquefaction by pressure, of the, so called, permanent gases, by Mr., now Sir Michael Faraday.* Among the ærial fluids, carbonic acid was distinguished as requiring a force of 36 atmospheres at 32° F. to coerce it into the liquid state. His ingenious and hazardous experiments were conducted in glass tubes; and he depended on the accumulation of newly generated gas for necessary pressure.

Mr. Brunel,† in a subsequent endeavour to apply compressed gases to mechanical purposes, produced a pint and a half of liquid carbonic acid, which, even at high temperatures, he confined in a series of small brass tubes not above the $\frac{1}{30}$ of an inch in the thickness of their walls.

This interesting subject was not again publicly agitated, until the appearance in December, 1835, of a report on the liquefaction of carbonic acid on a comparatively large scale. In the last number for that year of the *Annales de Chimie et de Physique*, M. Thillorier described the properties of liquid carbonic acid in detail. According to him this liquid demands for its existence as such at 32° F., a pressure, as stated by Sir M. Faraday, of 36 atmospheres. Its specific gravity is at the same temperature 0.830, at —4°F,—0.900, and at 86°—0.600. It is therefore enlarged by heat 3.407 times as much as its own or any other gas, when carried from 32° to 86°. From —4° to 32° its expansion is almost exactly equal to that of the gases.

M. Thillorier found also that the expansive force is altered by heat so as to amount at 86° to 73 atmospheres, and at —4° to 26 atmospheres. The density of the gas when resting over the liquid at 86°, is stated at 130 times the density of that which is compressed by the force of one atmosphere. Its pressure is therefore at 86° not much more than one-half of that which its density would indicate.

When liquid, the carbonic acid is, on the same authority, immiscible with

* Philos. Trans. Lond.

† Quart. Journ. vol. XLI.

water and the fat oils, but is readily united with ether, alcohol, naphtha, oil of turpentine and carburet of sulphur. Although potassium decomposes it, lead, iron, copper, and the other easily oxidized metals, do not act on it.*

The theometric temperature observed in the jet by Thillorier, appears to be erroneously stated; for, as the *solid* is, at its formation, not below —90°, and as the act of solidification of any vapour or liquid keeps the temperature, for the time, at the highest point compatible with the existence of the particular solid under observation, it follows that the jet of carbonic acid cannot fall below its freezing point. Immediately after its production, the carbonic snow begins to grow colder, and may be made to reach —109° in the air, —136° under an exhausted receiver. When moistened with ether, it can be depressed to —146°. Professor Hare's ether acts much more effectually than sulphuric ether.

At the immediately subsequent sitting of the Academy of Sciences, Thillorier announced the important fact that he had solidified carbonic acid. This he effected by suffering the liquid to escape into a bottle, or box, where by the sudden gasefaction of a part, the remainder was frozen by the extreme cold thus produced. The solid is white, light, evaporable and excessively cold. Because, surrounded by an atmosphere of gas which is constantly escaping from it, a fragment of it touched lightly by the finger glides rapidly over a plane surface.

Its evaporation is so complete as to leave no other trace of moisture than that which is caused by the coldness and consequent atmospheric humectation.

The force of its gasefaction is alleged to be equal to, but not so sudden as, that of gunpowder.

The temperature at which the solidification took place was presumed to be about —148°F; although the experiments before the committee of the Academy shewed —124°.

Such is, in substance, the account by M. Thillorier of his novel and curious discovery, reported in the *Annales de Chimie.* No description of the method of procedure, or of the apparatus used, is annexed; and we are left to conjecture, and to the imperfect description of travellers, for any farther knowledge of either.

Having repeated the experiments of Thillorier, I deem it not useless to subjoin a draught of the instrument with which, aided by the suggestions of an intelligent pupil in France, and the assistance of friends here, I was enabled successfully to repeat most of the experiments of Thillorier and to verify some, and correct other, of his results.

The apparatus consists of a generator of cast iron, A, supported by a wooden stand, B, a receiver, F, also of cast iron, connected to the generator by a brass tube, and fastened firmly to it by the stirrup screw, K,—H, I, J, are stop-cocks, G the nozle of a pipe, L a glass level-gauge, and S, M, R, a pressure-gauge.

The generator is 20 inches long and 6 inches in diameter exteriorly. Its cavity is 16 inches deep, and 3 inches, nearly, in diameter, so that it will hold about 4 pints. The walls are, of course, about 1½ inches in thickness. At the top an aperture of two inches in diameter is closed by a strong wrought-iron screw, the shoulder of which is let in about a quarter of an inch. The

*Among the most remarkable of the phenomena observed by Thillorier was the intense cold produced by the sudden liberation of the liquid and its conversion into gas. A jet of it depressed the thermometer to —130F., and when sulphuric ether had been previously mixed with the liquefied gas, the refrigerating effects were more marked both on mercury and the sensations.

collar is of block tin turned to the size of the shoulder of the screw. There is a hole in the head of the screw E for the reception of a long, strong, iron bar.

The copper cup, N, 1¼ inches wide, and 9 inches long, holds about 12 fluid ounces. There is a little handle at the top, and a copper wire at the bottom which make the whole length a little less than that of the cavity of the generator. This cup is used to introduce the sulphuric acid.

The brass tube between the generator and receiver is divided into two parts of equal length, which admit of being united by means of a conical juncture, kept tight by the stirrup and screw, K, K. Each of these portions of the tube may be closed or opened at pleasure by a stop cock. One is placed at I, another at J; so that when the receiver is being separated from the generator, the contents of both may be retained. The stop-cocks in common use are inadequate to resist the pressure, and therefore a screw stop-cock is indispensable. It is made to close a small aperture by means of a conical point, and having a double cone, it closes an outlet also when the cock is completely open, so as to prevent the escape of gas by the sides of the screw.

The receiver, F, is of the capacity of about a pint. The pipe, G, G, turned at a right angle at G, descends so as almost to touch the bottom of the cavity in F. The stop-cock H, G, is similar to I and J. L is a glass tube connected at each end to a socket of brass, which communicates with the interior of F. It is the gauge for observing the level of the liquid in T.

The gauge for measuring the pressure is peculiar. Into a wrought iron box, S, are inserted, by screws, two sockets, T and U. The former descends almost to the bottom of the box, which is nearly filled with mercury. Through the axis of the screw, X, a small tube passes into the cavity of S, and is continued to the top of it, so as to rise above the mercury. Two strong barometer tubes, R and M, are cemented* into U and W, and hermetically sealed at the upper ends. These tubes are carefully graduated. In one of them, U, a short cylinder of mercury is made to stand at Y at the commencement of the experiment. The other, socket and all, is full of air, as no mercury is introduced into it. A very fine screw at W, enables the operator to regulate the quantity of air in T.

The tin cup, O, used to collect the solid acid, is covered by a lid, Z, perforated by a pipe, P, whose top is full of small holes. The handle Q, is hollow, so as to fit the end of the pipe of the receiver at G. To secure the hand of the operator from the cold produced by the experiment, the handle is carefully wrapped up in some kind of cloth.

The apparatus is prepared for use by removing the screw E, and placing 1¾ lbs. of bicarbonate of soda in the generator, A, to which 24 fluid ounces of water are to be added. After making these into a thin paste by stirring, nine fluid ounces of common sulphuric acid are to be poured into the copper cup, N, and that is to be let down by a crook of wire into the generator. After the screw, E, has been firmly applied, and the stop-cock, J, closed, the contents of the generator are to be brought into admixture by moving it round to a horizontal position on the swivel, D, which is supported by the

* The cement used was made of shell lac 3 or 4 parts, white or crude turpentine 1 part, melted at as low a temperature as possible so as not to make bubbles in the mixture. This cement is very strong, but liable, without great care in the regulation of the heat, to have capillary tubes in it from the vaporization of the turpentine. This defect may be completely corrected by cutting away, when cold, the external mass of cement, and putting on a little common cap cement which melts at a much lower temperature and closes the tubes.

wooden frame, B, B. There is a check bar at C. This motion is to be repeated several times. In about 10 minutes the whole of the carbonic acid is liberated, and exists in A, chiefly in a liquid state.

The next step in the process is to attach by means of the stirrup and screw, K, K, the receiver, F, *previously cooled by ice.* The keys, I and J, may then be opened slowly, and instantly the liquid carbonic acid is perceptible in the gauge, L. At the end of 10 minutes the communication with the generator may be cut off—when about eight fluid ounces of liquid acid at 32° F. will be found in the receiver.

By letting this liquid into the box, O, through the pipe, G, a large part of it is instantly expanded into gas, which escapes through the tube, P. The coldness consequent on the enormous expansion freezes another part of the liquid, which falls to the bottom of O. About one drachm of solid matter is thus formed for each ounce of liquid.

The porosity and volatile character of the solid renders its specific gravity of difficult ascertainment. When recently formed it is about the weight of carbonate of magnesia, and when strongly compressed by the fingers, its density is nearly doubled. Solid carbonic acid is of a perfect whiteness, and of a soft and spongy texture, very like slightly moistened and aggregated snow. It evaporates rapidly, becoming thereby colder and colder, but the coldness produced seems to steadily lessen the evaporation, so that the mass may be kept for some time. A quantity weighing 346 grains lost from 3 to 4 grains per minute at first, but did not entirely disappear for 3 hours and a half. The natural temperature was 76°—79°. The solid is most easily kept when compressed and rolled up in cotton or wool. Its temperature when newly formed is not exactly ascertainable because it is immediately lowered by evaporation. Thillorier seems to have entertained the opinion that the greatest degree of cold was created at the time of the formation of the solid. In my experiments a constant decrease of temperature was observed; which was accelerated by a current of air, or any other means of augmenting evaporation. At its formation, the carbonic snow depresses the thermometer to about —85°. If it be confined in wool or raw cotton, its cooling influence is retarded; if it be exposed to the air, especially when in motion, the thermometer descends much more rapidly; and under the receiver of an air pump, the effect is at its maximum. The greatest cold produced by the solid carbonic acid in the air was —109°, under an exhausted receiver —136°, the natural temperature being at +86°.

The admixture of sulphuric ether so as to produce the appearance of wet snow, increased the coldness, for the temperature then fell, under exhaustion, to —146°,* a degree of cold which we were not able to exceed by means of any variation of the experiment. That result is most easily obtained by putting about two fluid drachms of ether into the iron receiver before charging it. A compound liquid may be thus formed which yields a snow in less quantity, but of a more facile refrigeration. Alcohol may replace ether in either mode, but with less decided effect. In the air the alcoholic mixture fell to —106° and remained stationary. By blowing the breath on it, it fell to —110. Left to itself it rose slowly to —106°; but on being placed under an exhausted receiver fell to —134°.

Every attempt to wet the carbonic solid with water, failed, so that no estimate of its relative effects could be made.

The experiments resulting from the great coldness of the new solid, were

* As $-146+32=178$, the cold is nearly as far below the ice-point as $212-32=180$ is above it.

very striking. Mercury placed in a cavity in it, and covered up with the same substance, was frozen in a few seconds. But the solidification of the mercury was almost instantly produced by pouring it into a paste made by the addition of a little ether. Frozen mercury is like lead, soft and easily cut. It is ductile, malleable, and insonorous. Just as it is about to melt, it becomes brittle or 'short' and breaks under the point of a knife. These facts may account for the discrepancies of authors on this subject. Frozen mercury sinks readily in liquid mercury.

At about —110° liquid *sulphurous acid* is frozen, and the ice sinks in its own liquid, and at —130° *alcohol* of .798, assumes a viscid and oily appearance, which by increase of cold, is augmented until at —146° *it is like melted wax.* Alcohol of 820 froze readily.

At —146° *sulphuric ether* is not in the slightest degree altered.

When a piece of solid carbonic acid is pressed against a living animal surface, it drives off the circulating fluids and produces a ghastly white spot. If held for 15 seconds it raises a blister, and if the application be continued for 2 minutes a deep white depression with an elevated margin is perceived; the part is killed, and a slough is in time the consequence. I have thus produced both blisters and sloughs, by means nearly as prompt as fire, but much less alarming to my patients.

The specific gravity of liquid carbonic acid may be estimated either by weighing a given measure of it in a tube, and deducting the weight of the tube, and of the superincumbent gas, or by means of very minute bulbs of glass as suggested by Sir M. Faraday. By the latter means I obtained the following results, which are compared with those of Thillorier.

		Thillorier.	
Temp. Fahr.	Sp. Gr.	Temp. Fahr.	Sp. Gr.
32°	.93	32°	.83
43°.5	.8825		
51°	.853		
74°	.7385		
86°		86°	.60

The specific gravity particularly at 32°, was examined repeatedly, and with different bulbs, and always found to be at, or very near, to .93. The difference never amounted to .005. The sp. gr. as given by Thillorier at 32° is 83. The anomalous expansion of the liquid as indicated by both sets of experiments is truly surprising. By mine 73.85 parts raised from 32° to 74°, or 42°, become 93 parts, and gain 19.15 parts, while the same bulk of the gases acquires in the same range of temperature only 6.46 parts, or the liquid is expanded very nearly three times as much as its own or any other gas. According to Thillorier, 60 parts gain 23 parts by an elevation of 54°, while the same bulk of air would under like circumstances be augmented only by 6.75 parts; or the liquid is nearly four times as expansive as the gases.

As below 32°, or at reduced pressures, the augmentation of temperature is productive of much less expansive influence, we may infer that under the weight of a few atmospheres, as when near to its freezing point, liquid carbonic acid is scarcely more dilatable by heat than water. Between —4° and +32°, its expansion is 0.053 while that of air is 0.069. These facts suggest the inquiry how far water at *very high temperature and pressure* may be obedient to the same expansive influence, and thus by suddenly filling the whole interior of a boiler, sometimes cause explosions.

The pressure of carbonic acid gas, when placed over its liquid, is given

by Thillorier at 32° and 86°, as 36 and 73 atmospheres respectively. By means of the gauge S, M, R,—I found the pressure as follows:

32°	36	atmospheres.
45°	45	do.
66°	60	do.
86°	72	do.

The principle of the gauge renders it capable of registering the pressure with great accuracy:—for as one tube, M, begins to mark the pressure from the commencement of an experiment, and the mercury in the other, R, does not reach a visible point until the first has shewn a pressure of several atmospheres, the second tube is equivalent in effect to one of several times its length. The first determines the amount of pressure, at which the mercury reaches the initial point on the 2nd, and the 2nd, subsequently, exhibits the multiplicators of that initial quantity. Thus, if when the mercury is at five atmospheres in M, it is at the unit mark in R, the value of that unit will be five, and the numbers representative of the pressure on R, must be multiplied by five; or R is equal in effect to a tube of five times its length. By these means very short tubes may be used to determine very high pressures. Inequalities in temperature, irregularities in the cement, and other causes, may vary the capacity of the socket T, W, but as M always signifies the unit for R, in each case, no error can arise from these causes. There must, of course, be a correction for the weight of the mercurial column in R, which is to be added to the product. Care must be taken to keep the temperature of the vessel which holds the liquid below that of the gauge and tubes, otherwise the liquid will be formed by condensation in the latter. This actually happened in the attempt to ascertain the pressure at 86°, when the natural temperature was 75°. Bubbles of gas were seen ascending through a liquid in M, up to its surface at a few inches below the mercurial cylinder. This as far as relates to the tubes may be avoided by prolonging the socket of M, down into the mercury of the cup, so as to include a cylinder of common air between two cylinders of mercury, and prevent any carbonic gas from entering either the socket, or the glass tube. A correction for the weight of this column, must in such case be made.

When a glass tube, hermetically sealed at one end, and cemented into a brass socket and screw at the other, is attached to a charged receiver and cooled by snow or pounded ice, liquid carbonic acid may be collected in it. It is perfectly colourless and transparent, and the specific gravity bulbs, previously introduced, are seen to ascend or descend, as the temperature is altered. When the tube so charged is opened, the liquid becomes violently agitated, escapes rapidly, grows colder and colder, and finally the remainder is converted into a solid, more dense than the snow already described, but nearly white, and very porous. If the tube be exposed to a paste of carbonic snow and ether, the liquid is solidified into a mass which is not porous but which sinks in the liquid as the latter is formed again by the melting of the solid.

The analogy between liquid carbonic acid and water, is thus completed for we have liquid, vapour, snow, and ice, exhibited by both.

By the previous introduction of water, ether, alcohol, metals, oxides, or oils, &c. into such tubes, and then filling them with liquid carbonic acid, the resulting phenomena may be easily observed. Water being heavier rests below the new liquid, and does not appear to mingle with it even at the surface of contact, for when the latter is let off, no bubbles appear in the water, and it is frozen at the top into a solid ice.

When alcohol or ether is introduced, the new liquid falls through it in streams, as water would do, but soon renders it milky by mixture. The removal of the pressure causes a violent effervescence, and immediately the clear, colourless ether, or alcohol, is seen alone in the tube; no solid being formed. When alcohol holds shell-lac in solution, the acid causes its precipitation in light whitish flocculi, which are immediately re-dissolved when the acid is suffered to fly off. Nothing remains but the brown lac-stained liquid.

Liquid carbonic acid did not appear to act on any of the metals or oxides, but the experiments on this point demand a further examination. Its inaction is probably owing to the want of the force of 'presence,' or of 'disposing affinity.'

When the liquid has been frozen in a tube of glass, the tube may be melted off by the blow pipe, and hermetically sealed. Such a tube will always retain the liquid, or gas, the former, if in sufficient quantity, at all temperatures, if not, the latter alone will be found in it at high temperatures. I have one such tube, which begins to shew moisture at 56°, and exhibits a constantly elongating cylinder of liquid, as the coldness is increased. At 32° the cylinder is about half an inch in length.

Carbonic acid mechanically powerful as it is, is not applicable, perhaps, either to locomotion or projection; but though the reasons for this are most of them obvious, the Franklin Institute has appointed a committee to investigate and report on the subject, that the exact truth may be known, and the waste of time and talent likely otherwise to be experienced, be saved to the country.

Physical Science.

FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

Cubes and Squares.

In reading the account, in the Journal for August, of Mr. Turner's theorem for finding the cubes by the addition of the groups of *odd* numbers, I was led to the consideration of cubes and squares, and made the following discoveries: at least they are discoveries to myself, as I know not that they have before been adverted to.

I. *For the Cube.*

Take the series of *even* numbers and divide them into groups of two, three, &c., terms consecutively, and put the figure denoting the number in each group at the top. The sum of each group, with the addition of the number denoting the group, (or, what is the same, the addition of the number of the figures in the group,) makes the *cube* of that number. As,

$$2\ \overset{2}{4}\ \Big|\ 6\ \overset{3}{8}\ 10\ \Big|\ 12\ 14\ \overset{4}{16}\ 18\ \Big|\ 20\ 22\ \overset{5}{24}\ 26\ 28$$

The cube of 2 is $2+4+2 = 8$.
The cube of 3 is $6+8+10+3 = 27$.
The cube of 4 is $12+14+16+18+4 = 64$.
The cube of 5 is $20+22+24+26+28+5 = 125$.

II. *For the Square.*

Divide the natural numbers into groups,—not of one, two, three figures,

&c,—but of *even* consecutive numbers, groups of 2, 4, 6, 8, &c., and number the groups 1, 2, 3, 4, 5, &c. In the first group the first figure is the square of 1; in the second group the second figure is the square of 2; in the third group the third figure is the square of 3, &c.: As,

1 2 3 4
1 2 | 3 4 5 6 | 7 8 9 10 11 12 | 13 14 15 16 17 18 19 20

Or the squares may be found without groups, by the constant addition of 2, as follows. The square of 2, which is 4, is the *third* figure from 1, the first square: the distance of every subsequent square increases by 2: that is, the square of 3 is the *fifth* figure from 4, the square of 2; the square of 4 is the *seventh* figure from 9, the square of 3; the square of 5 is the *ninth* figure from 16 the square of 4, &c. Thus,

1 2 3 4
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23
5
24 25

Having a series of natural numbers, the roots 1, 2, 3, &c., may thus be put over their squares. It may be seen, that the distance from 4 to 9 is 5 figures; from 9 to 16 is 7 figures; from 17 to 25 is 9 figures; and so on, increasing by 2.

Or the squares may be found as follows: Divide 1 from the other numbers; then for *even* roots take as many of the next even numbers as are equal to the root; and for *odd* roots take as many odd numbers as are equal to the root: the last figure of each group gives the square of the number of the group. As,

1 2 3 4 5 6
1 | 2 4 | 5 7 9 | 10 12 14 16 | 17 19 21 23 25 | 26 28 30 32 34 36

It is seen, that there is an alternation of groups of even and odd numbers. The omitted figures are less in number by one, than the number of each group.

The square of any number being known, the square of the next number *above* is ascertained by adding to the known square the sum of the two numbers. As, the square of 40 being 1600, the square of 41 is $= 1600 + 40 + 41 = 1681$.

Of course the square of the next number *below* the number, whose square is known, is ascertained by deducting the sum of the two numbers from the square: 1681 being known as the square of 41, subtract $41+40$ from 1681, and it gives the square of $40=1600$. W. A.

Mechanics' Register.

List of American Patents which issued in January, 1838.

With Remarks and Exemplications by the Editor.

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1. For improvement in the *Loom for weaving knotted Counterpanes*, and other fabrics in which the woof is raised from the surface; Erastus B. Bigelow, West Boylston, Worcester county, Massachusetts, January 6.

The claims made are, "1st. Raising the knots which compose the figure, from the surface of the cloth, by a series of movable dents, or teeth, or

hooks. 2d. Supporting the woof during the operation of the movable dents, or teeth, or hooks; and thereby regulating the length of the knots by a bar, beam, or race piece, as described. 3d. Separating, or dividing asunder, the threads of the warp, by means of beveled pieces of metal on the sides of the movable dents, or hooks, or teeth, to prevent them catching into and breaking the threads. 4th. A toothed cylinder, or cylinders, acting on machinery intervening between them and the dents, or teeth, or hooks, successively to raise the knots which compose the figure. 5th. The application of a prism and pattern card to produce the variations in the pattern, or figure."

Accompanying the specification of this patent are five sheets of drawings, affording a clear view of the invention, of which no adequate idea can be furnished without such aid.

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2. For a machine for *Crimping Leather for Boots;* Lucius Upham, Putney, Windham county, Vermont, January 9.

A common boot crimp is taken, and the back edge of it is cut away at the heel, and contiguous to it at the leg and foot, so as to admit three double blocks of about three inches long to occupy the place of the removed stuff; the pairs of blocks lay side by side, and are coupled together by wire staples, forming loops at their backs, each pair having two staples. Through each block passes a screw which is to bear on the back edge of the crimp, and when the leather is tacked on, it is to be strained by turning the screws. The claim is to "the application of the six blocks connected by staples, and moved by screws, in the manner before described; to move independently of each other, or simultaneously, as the leather may require."

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3. For a machine for *Moulding, and off-bearing, Brick and Tile;* Loomis E. Ransom, Millport, Chemung county, New York, January 9.

The prepared clay is put into a hopper, or box, from whence it is forced into the moulds placed in front of the hopper, which is open for that purpose. The hopper, and the frame of this machine are so formed that the moulds when being filled, slope back at an angle of from five to ten degrees, giving them a tendency to fall towards the table in front, and preventing the clay from falling out. There are ribs in front of the hopper, so formed and placed as to divide the clay and conduct it into the moulds. The follower which fills the moulds works horizontally from the back of the machine, it rests on the bottom of the hopper, and slides in grooves, being operated on by a treadle. When the moulds are filled, strikers, formed of plates of metal, are brought down; there is one of these strikers to each brick, and it is guided by a rebate, or groove on the ribs. The lower ends of the strikers are sharp, and curved crosswise. The claims are:

"1st. The manner of conducting the ribs of the grating, and of arranging them as described.

"2d. The method of constructing the strikers as above described, with the lower ends curved forward, to prevent the clay adhering to the face of the strikers.

"3d. The arrangement of the inclined frame to give the moulds an inclining position forward, in order to cause the clay, by its gravity, to fall into the moulds after being cut, and to enable the operator to remove them with ease as above described."

4. For *Strengthening the axles of Rail Road Cars and Locomotives;* Ziba Durkee, Philadelphia, Pennsylvania, January 9.

Upon the middle of each axle there is placed an iron cylinder, having flanches rising from each of its ends, giving to it the general form of a common bobbin. These flanches are each to have holes through them to receive the ends of rods of iron, the other ends of which pass through iron plates placed on the face of each wheel, and surrounding the hubs; there may be four, or any preferred number, of such rods, which are to be drawn tight by nuts and screws. This, the patentee says, will "greatly strengthen the axle, and prevent it from breaking, and support the wheels should an axle break. With this attachment a smaller axle than those now in use will answer every purpose." The claim is to the above "mode of strengthening the wheels and axles of locomotives and rail road cars, by the combination of the cylinder, plates, and rods, constructed and connected substantially as within described."

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5. For an improvement in the *Machine for breaking Flax and Hemp;* Andrew Forsyth, Columbia, Maury county, Tennessee, January 9.

This machine is constructed like the common hand break, but the slats forming the bed, are placed upon springs, that they may yield in some degree to the stroke. This constitutes the whole of the so called improvement, and is, of course, the only thing claimed.

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6. For an improvement in the mode of *Attaching Springs to Carriages;* David A. Morton, Groton, Tompkins county, New York, January 9.

To the underside of the bottom of a carriage, are to be fixed cases, or tubes, running lengthwise, and near to each side. Within these cases there are to be spiral springs, wound so as to leave a space between each coil, to allow of their being drawn together. Rods passing through these springs have straps attached to them, which straps extend out at either end and wind round a cylinder fixed upon a shaft for that purpose. To the jacks by which the body is to be suspended are also attached straps which in like manner wind around cylinders upon the same shaft with the straps first named, but in a reverse direction. The straps which are attached to the springs pass over rollers at the ends of the spring case, to conduct them to the cylinders upon the shaft. Different modes of modifying these springs, straps, cylinders, and their appendages, are pointed out by the patentee; there may, for example, be but one spring case along the centre of the carriage body, or the spiral springs may be affixed without their being enclosed in a case.

The patentee says "it will appear obvious that when the body is thus suspended and the carriage is in operation, a portion of all the straps are alternately unrolling and rolling up on the cylinders. When the body settles, a portion of the straps attached to the springs are at the same time taken up, which will consequently contract the springs. When the body rises a portion of the straps attached to the jacks are taken up, and a portion of those attached to the springs are at the same time thrown off, which will necessarily elongate the springs."

"What I claim as my invention and desire to secure by letters patent, is the combination of the above described rollers, the straps, and the irons by

which the springs are contracted, with horizontal spiral springs attached to the under side of the carriage body as herein described."

There is certainly much ingenuity in the above described arrangement, and, so far as we know, it is essentially new; and we think also that these springs will operate pleasantly; the great objection to them is their liability to fracture, an accident of frequent occurrence in spiral springs similarly acted upon.

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7. For a machine for *sowing Plaster, Ashes, and other separable substances;* Julius Natch, Great Bend, Susquehanna county, Pennsylvania; first patented August 17th, 1835. Surrendered and re-issued January 9.

This machine was noticed at p. 204, vol. XVII, but with a mistake in the name, the patentee being called Notch, instead of Natch; we there remarked upon the defectiveness of the specification, a fault which the new one is intended to cure. The following are the claims now made:

"The invention claimed by me the said Julius Natch, and which I desire to secure by letters patent, consists in the combination of the slide or agitator and hopper, as described, for agitating the substance in the same to be sown, so as to cause it to pass from the hopper regularly and evenly. I likewise claim the gauges for regulating the swinging parts of the hopper, whether constructed as herein set forth, or in any other manner substantially the same in principle."

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8. For an improved *Machine for cutting Straw, and other substances;* Edwin Gillett, Ellington, Tolland county, Connecticut, Jan. 9.

In the general construction of this cutting machine there is not any thing new. The straw to be cut is placed in a trough, and is fed to the knife by a comb-like plate, denominated vibrating fingers. The knife is attached to a vibrating frame worked up and down by a crank, in the ordinary way. The things claimed are a "spring rest in front of the knife, in combination as described; and the method of feeding the vibrating fingers."

The spring rest consists of a bar of iron, or of steel, in front of the cutting box, and between which and the fore end of the box the knife is to pass; said spring rest having a yielding motion, for the purpose, it is said, of preventing the clogging of the machine. We have seen many similar machines work, but we never witnessed the necessity for such a contrivance, nor are we very certain that the proposed effects would be produced by it. A rod extending from the crank to the feeding comb, or vibrating fingers, is designed to give the required movements to that article.

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9. For improvements in the mode of *Constructing and operating Churns, &c.;* S. P. W. Douglass, Lansingburgh, Rensellaer county, New York, January 9.

This patent is taken for a peculiar mode of giving to the dasher of the common vertical churn a rotary, as well as the ordinary vibrating motion, and the mode described of doing this forms the subject of the claim.

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10. For an improvement in the *Machine for planing plank, boards, and clap-boards;* Barnabas Langdon, Troy, Ransellaer county, New York, January 9.

"The nature of my improvement consists in providing machinery, that in

its operation will produce an horizontal reverberatory movement by which the plank, or board, is driven in a lengthwise direction before a stationary plane stock set with cutters, so as to plane and smooth the plank, reducing it at the same time to the required uniform thickness; and also by providing an additional apparatus for the purpose of grooving, tongueing, and straightening its edges, all at one operation."

The claims made are to certain "grooves, or channels, in the faces of the plane stocks, with the arrangement of the cutters corresponding with the grooves, whereby the extra thickness of the plank is taken off, or reduced, with greater ease and effect. The particular arrangement and construction of the plates, or slides, to which the cutters are fastened. The clamps with the back plates for guiding the planks, or boards, and keeping them in a straight direction. The iron slides with their springs for supporting the plank in the operation of planing," &c.

The foregoing claim relates to certain particulars in the construction, which are represented in the drawing. The machine itself is of double the length of the stuff to be planed, so that for boards of eighteen feet in length, the bench would be upwards of thirty-six feet. Under the bench there is a rack, driven backward and forward by a pinion, with a reversing motion. The plank stands edgewise, between two cheeks, and from the upper side of the rack rise two drivers, which are to bear against the back end of the plank and force it forward. At each end of the bench there are sets of irons, or cutters, placed one behind the other, to cut the stuff in succession; these cutters operate like ordinary plane irons, and stand vertically. The devices for planing clapboards, &c. we shall not attempt to explain. To the machine, in its general construction, there is not any claim; we think, however, that it possesses sufficient novelty to have justified one, without limiting the claims to its individual appendages.

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11. For improvements in the *Machine for shaving Shingles;* Barnabas Langdon, Troy, New York, January 9.

The claim is to "the slide with its seat or checks, for holding the shingle and giving it its proper taper; the manner of securing it in its bed by means of the clamps, and carrying it before the face of the plane, and also the general combination of the different parts," &c. These claims refer to the peculiarities of construction devised by the patentee; but the machine does not otherwise differ materially from such as have been previously made.

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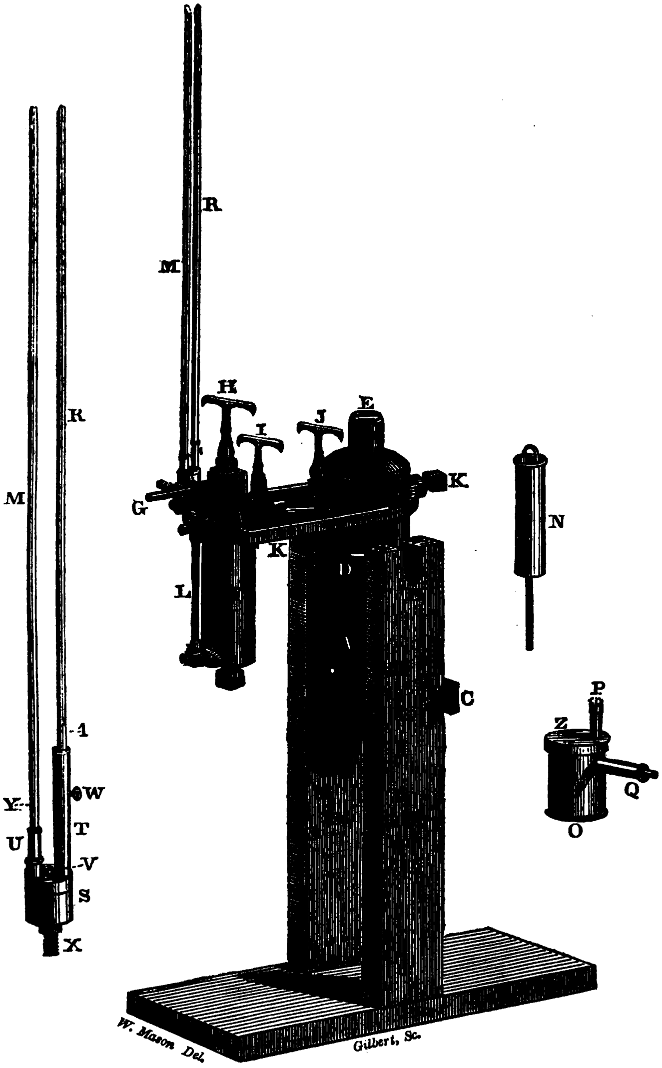
12. For an improvement on the *Planing Machine,* for which a patent was obtained August 28th, 1833; James McGregor, Wilton, Saratoga county, New York, January 9.

The original machine is noticed at p. 120, vol. XIII; the improvements now added have undoubtedly much enhanced its value. A good general idea of them may be obtained from the following claims:

"The first improvement which I claim consists in the new arrangement of the tongueing saws, namely, in the first jointing of one edge by a circular saw upon the first saw shaft, and the subsequent jointing of the opposite edge, whilst the edge first jointed is at the same time effected, at a point opposite, or nearly opposite to the second jointing saw. My second claim to improvement is to the employment of the gauge strip, in the manner and for the purpose set forth." There are some other claims, but from the nature of the machine a drawing would be required to make them understood.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13. For improvements in *Locomotives and Rail Road Cars;* Jonas P. Fairlamb and L. C. Judson, city of Philadelphia, January 9.

Claim.—"What we claim as our invention and desire to secure by letters patent is the construction and application of the *cylinder bunts*, to graduate the concussion of two bodies coming in contact. The construction and application of the *safety guard clamps* to wheels, to avoid danger when an axle breaks. The application of *small truck wheels* to guard against danger when a large wheel breaks. The *spring lever*, and mode and manner of guiding cars from one track of railway to another without the use of switches; and the construction and application of the *double universal joint*, each part as specified and described."

What the patentees call cylinder bunts is a new form of buffing apparatus, to ease off the blow when two cars, &c., come into collision. It is proposed to have strong metallic cylinders bored out in the manner of cannon, and into these to fit pistons, with rods projecting out, and covered with some elastic material, to receive the blow; within the cylinders are to be placed spiral springs; but the principal dependance is upon the elasticity of the air, re-acting upon the piston. "It is believed that with four such cylinders of twelve inch calibre, eight feet in length, two inches thick, of sound cast iron, well hooped with first rate wrought iron upon each, two locomotives may meet when going at the rate of thirty miles an hour without sustaining any damage." *Credat Judaeus.*

The safety guard clamps are to extend over each wheel, and come nearly in contact with the hub on each side, so that in case of the breaking of an axle, they shall form bearings by being brought into actual contact.

The spring-lever, which is to be a substitute for switches, is to be attached to the frame of each set of wheels of an eight wheel car in such a manner as that by pressing upon them they shall direct the cars; how this is to be effected is by no means clearly made known.

The double universal joint is to connect cars together, and to be used in lieu of the devices now employed.

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14. For *apparatus for leaching Ashes*; Elijah Williams, Westfield, Chautauque county, New York, January 9.

This patent is taken for a particular mode of constructing the apparatus for leaching ashes; the claims made being to "the use of a boiler like that described, furnished with a safety tube, for the purposes set forth."

The ashes are to be boiled, and afterwards strained, in the apparatus described, the superiority of which over the means in ordinary use is not very apparent; the organ of novelty is very small, that of utility we have not been able to discover.

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15. For an improved *Canal Boat;* Edward Randolph, Salt Creek, Muskingum county, Ohio, January 9.

This is a contrivance which differs but little from some that have preceded it, but still sufficiently to obtain the grant of a patent. The boat is to be of the twin kind, with a paddle wheel in the centre. The principal dependence for its utility is upon its leaving the waters unagitated by the aid of a fender board, and a smoothing board, which are thus claimed. "What I claim as my invention, and desire to secure by letters patent, is the way

the wheel is hung in a square trunk formed by the fender board under the wheel; and also the smoothing board hung behind the wheel, so as to discharge the water without doing any injury to the banks of the canal."

Methods very similar have been before essayed, but the great difficulty in attaining this long sought end has not been removed, and from the obstinacy of its character is likely always to remain in full force. Canal boats will displace a portion of water equal in weight to themselves, and to that of their load, and this must be constantly flowing back as the boat advances in order that the cavity may be filled, which must otherwise be left at her stern This is in conformity to a law of nature which has existed throughout all time, and one which nature alone can repeal.

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16. For an *Apparatus for Steaming, Boiling, &c.;* B. F. Gold, city of New York, January 9.

This contrivance is merely a double cover of tin, enclosing air between the two laminæ, and to be placed like a dish cover, over articles to be boiled, &c. The claim is to this contrivance.

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17. For improvements in *Scales, Beams and Weights;* Alvah N. Free, city of Troy, New York, January 9.

The claim made is to "the making the upper edge of the scale beam on which the poise, or weight, hangs, smooth and even, and combining therewith a poise having a pointer, or pointers, as described." The beam is divided on the side in the usual manner of steelyards, and a pointer rising from the top of the poise indicates the weight of the article weighed, by the divisions and the respective figures marked on the beam.

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18. For a *Machine for washing and pulverizing potatoes in the manufacture of Starch;* Sylvanus Richardson, Jerico, Chittenden county, Vermont, January 9.

This is an apparatus in which a revolving shaft, furnished with arms set obliquely, operates upon the potatoes within a circular trough kept filled with flowing water; they are conducted into a hopper, by the action of the apparatus, and from the hopper pass under a grating cylinder; they then drop between rolling cylinders, by which they are reduced to a complete pulp, and are thus prepared for the making of starch from them. The individual parts of the apparatus are not claimed, but the inventor says that he is "not aware that the trough for washing, with its appendages, and the graters and rollers in their present arrangement, and for the uses and purposes set forth, have ever been before so used. He therefore claims as his invention the washing trough and its appendages in combination with the grater and rollers, in their arrangement and combination as described, for the uses and purposes herein before described."

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19. For an improvement in his *Patent Lamp, and in other analogous Lamps;* Samuel Rust, city of New York, January 9.

This improvement consists in the manner in which a shade is added to the lamps previously patented by Mr. Rust; the roller for raising the wick; its connexion with the stopple and tube being the same as formerly.

20. For applying a shade to the *Lamps* formerly patented; Samuel Rust, city of New York, January 9.

This patent, as will be seen by the title, is for a purpose similar to the former, the mode of fixing and arranging being sufficiently different, however, to induce the taking of a separate patent.

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21. For a *Cooking Stove;* E. L. Parshley and B. Furbish, Brunswick, Cumberland county, Maine, January 9.

The difference between this and several other stoves, is very slight. The claim is to "the particular mode of arranging the plates for conducting the draught down behind the fire, under, and up at the back of, and then over, the oven, to the front thereof, and thence back under the boiler, or boilers, to the escape flue at the back of the stove." The apparent novelty is the insertion of a plate between the top plate of the oven and the top plate of the stove, reaching entirely back to the back plate, so as to bring the draft to the front from the back, and carry it thence back to the smoke pipe at the rear end of the stove.

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22. For improvements in the *Machine for rubbing and hulling Rice and other grain;* Alfred and William J. Duvall, city of Baltimore, January 9.

A hollow cylinder is to be made of cast-iron, which is to be formed of staves, and hooped together. Within this is to be placed a cylinder which is to revolve within it, having a space of two or three inches between the two. The outer cylinder, which is to be stationary, has teeth, or short arms, projecting inward, and the inner cylinder has corresponding teeth projecting outwards, which pass between the former. The grain is admitted through openings in the head of the machine, and discharged at its lower end. The claim is to "the mode of constructing the cylinder and runner with teeth passing between each other in the manner described." Machines for the same purpose, and consisting of one vertical cylinder revolving within another, and armed with teeth, have been long in use; the teeth, however, have been generally such as to operate like graters, whilst those used in the present machine act as stirrers and agitators; our impression is that if all the models formerly existing in the office were still there, some having a near approach to this would be found.

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23. For a *Spherometer for ascertaining the relative Bearing of Places;* Cephas Johnson, Southington, Hartford county, Connecticut, January 9.

The claims made are to the manner of combining together the several graduated plates, and arcs of circles adopted by the patentee, "namely, the compass, divided into two separate parts, set vertically on the opposite side of a circle, having the eastern points on one part, and the western points on the other part; the part on which the western points are marked standing on the eastern side, and that on which the eastern points are marked standing on the western side of the instruments. The prime vertical in the form of a semicircle attached to the compass plates, turning on its ends to correspond with said plates, beviled on the inner edge, graduated for measuring geographical miles, and having shoulders projecting to indicate the point of the compass. The movable meridian in the form of a semicircle,

beviled on both edges, intersecting at once the prime vertical and equinoctial circle, and turning on pivots at the ends; the sliding meridian moving horizontally around a circular plate; the equinoctial circle set vertically, beviled on its circular edge, and graduated on both bevils, commencing at opposite ends on each bevil; the junction of the equinoctial circle at its base with a circular plate; all combined and made to move in the manner set forth; to produce, and, by such combination and movements of the movable parts, producing the effect of ascertaining the relative bearings of places, directing a ship by the shortest course from one place to another, running lines, and determining true distances."

After this imposing array of claims it will not be expected that we shall undertake to describe, and discuss, the merits of an instrument consisting of so many parts. We are apprehensive that this, like many similar instruments, will serve better to display the skill of the contriver, than to fill his pockets by coming into extensive use.

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24. For an improvement in *Carriage Springs;* William Patton, Towanda, Bedford county, Pennsylvania, January 9.

There have been several patents issed within a few months for various modes of constructing springs for carriages; most of them are contrivances of little or no value; in many instances they bear so close a resemblance to each other as to show that they are the results of imitation; a fact which would be still more strikingly exemplified were we to publish the applications for similar patents which have been rejected. Where patents have been granted, the things claimed have, of course, been supposed to possess some novelty, whatever doubt may have existed respecting their utility.

The claim in the patent before us, is to "the adding to, and combining with, the semi-eliptical, or cradle spring, straight bars, cross beams, double bows, or projecting standards, one or more flat spiral springs, constructed as described." The spiral springs are placed, and operate, between the upper and lower springs, in a manner differing but little from those patented by William Croasdale, the specification of which will be found at p. 235, vol. xx.

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25. For improvements in the *Machine for Mortising and Dovetailing;* John Brainard, Aurora, Portage county, Ohio, January 9.

In this machine the mortising chisel is worked up and down by a toggle joint, to one of the bars of which a handle is affixed, which projects out like a pump handle; the stuff is placed on a bed, and otherwise managed in the ordinary way. As respects dovetailing, there is little probability of the machine ever being used for this purpose, as there is no particular provision adapting it to this object, the stuff to be dovetailed being placed upon the bed, and moved by hand so as for the chisel to cut as it does in mortising. The claim is to "the combination of the toggle joint, handle, and chisel stock, applied to mortising and dovetailing, as described."

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26. For an improvement in the mode of *Hanging Doors, to prevent rain from being forced under them by Wind, &c.;* Edmund C. Tilson, Thomaston, Lincoln county, Maine, January 9.

The claim is to the "letting a door down an offset in the threshold when

shut, to prevent the rain from driving under the door into the building; and the method of raising the door so as to swing over the stool, and of sustaining it at pleasure when closed, as described."

The inventor says, "my invention consists in making a perpendicular offset in the doorstool, or threshold, of about half an inch below the level of the highest part of the stool, so that the door when closed may be let down, or if not obstructed will slip down of itself, the depth of the offset, leaving the top ridge of the stool elevated thus much above the bottom of the door on the inside, but not on the outside; and in placing over the door, within or behind the inside casing, a lever moving on a pivot, midway from the short end of which a rod is let down connected by a spur with the heel of the door, so as to raise it when a power is applied to the other end of the lever, which is done by letting down a rod from that end also, with a small chain at the lower end to wind it on the windlass in the wall by a knob or crank on the outside of the casing. And also in making an offsett in the eye, or joint of the door hinge, so that one leaf of the hinge may slide down on the connecting wire, half an inch below the other when the door is shut; and placing a slide in the jamb casing at the heel of the door, to slide under the door to keep it up to its swinging level in fair weather, or when there is no occasion for letting it down."

Both ingenuity and skill are displayed in the contrivance alluded to, but there are others which have been devised, consisting of fewer parts, which have nevertheless been abandoned on account of their complexity and liability to derangement.

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27. For improvements in the *Machine for Boring Framing Timber*; Jared Badger, Brooklyn, Windham county, Connecticut, January 20.

This machine is constructed so that its frame may be moved along, and affixed to the timber to be bored, preparatory to its being mortised. By turning a winch, two vertical shafts geared into each other, and carrying augers at their lower ends, are made to revolve. Such a machine may be modified in so many ways as to render it difficult, if not impossible, to construct one which will secure any available right to its inventor, as the claim must necessarily be confined to special contrivances, which admit of the substitution of others equally efficient. In the present case the claims are confined to "the mode of regulating the auger, or augers, crosswise of the timber, by means of slides at the top and bottom of the box, or carriage, as described.

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28. For a *Machine for Sowing or Planting Ruta Baga, and other seeds or grain*; Hiram R. Merchant, Guilford, Chenango county, New York, January 20.

This resembles many other planting machines, as, indeed must necessarily be the case where contrivances for the purpose have been so numerous. It has two handles, and a single wheel, which rolls on the ground like that of a wheelbarrow. The hopper which is to contain the seed, is placed in advance of the wheel, and has in front of it a share for making a furrow into which the seed is to be dropped, and behind it two scrapers to close the ground over the seed, after which follows the wheel, or roller. The claim is to the mode of "construction, in placing the hopper forward of the

wheel, causing the wheel to answer the double purpose of wheel and roller; also, the manner of moving the slide, and scraping the dirt from the wheel."

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29. For improvements in the art of *Measuring and Cutting Garments;* William and Charles Kahlen, Bloomsburg, Columbia county, Pennsylvania, January 20.

The specification of this patent is a little MS. volume of diagrams and description, consisting of about twenty pages. We have so frequently confessed our lack of learning in the mathematics of tailoring, as to render unnecessary any excuse for not, on the present occasion, offering a review of the treatise before us. The authors have not furnished any summary of its contents in the form of a claim, this being diffused over the whole work, and the system, in its general features, being considered as essentially new.

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30. For improvements in the *Common, and Power, Loom;* Benjamin Lapham, Waterford, Saratoga county, New York, January 20.

"The nature of my invention consists in employing a spring to move the *wagstaff* in throwing the shuttle, and of dispensing with the ordinary *picker, picker strings* and *picker rods*, commonly used in the power loom; which I effect by straining a spring gradually during a full revolution of the cam shaft, by which the necessary force to throw the shuttle is acquired by an easy and uniform resistance to the driving power, exerting that force, always certain, under any speed of the loom."

"What I claim as new, and desire to secure by Letters Patent, is the manner of applying the principle of gradually accumulating a deposit of power to throw the shuttle, whether it be by the use of straining a spring or by raising a weight, as herein described. And secondly, the particular device specified, taken and considered as a combination of old methods to produce a new result."

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31. For an improvement in the *Furnaces for Stoves* for burning anthracite; Eben Eaton, city of Troy, N. York, January 20.

This stove is to have mica sash on each of its sides, the cast iron plates being as entirely composed of open work as is compatible with its construction. The grate which is to contain the fuel is a kind of basket grate, composed of fine separate pieces, which when properly combined, form a hollow cylinder intended to revolve on an axis, with which it is provided for that purpose; the particular manner of forming this grate is set forth in the specification, and the claim made is to "the furnace constructed, substantially in the form above described, or with such variations only as will not alter its character, or mode of operation.

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32. For a machine for *Trashing Grain and Shelling Corn*; Myron T. Gilbert, city of Troy, New York, January 20.

This machine is a combination of the ordinary thrashing machine, with its toothed cylinder and concave, and of that kind of corn shelling machine in

which a revolving plate is used, set with teeth. The shelling plate, or disk, constitutes one end of the thrashing cylinder, and the corn to be shelled is fed in at one side of the machine in the usual way. There is a shelling plate forming a segment of a circle, say one third, which is of cast iron, and has teeth on it like those of the revolving disk, opposite to which it is placed so that the ears fed in shall pass between them. The claim is to "the mode of constructing the thrashing cylinder and shelling wheel, as before described, being cast in one piece. And the combination and arrangement of the thrashing cylinder and concave with the shelling wheel and segment plate in one frame, for thrashing grain and shelling corn at one operation.

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33. For improvements in the *Apparatus for Diving*; William H. Taylor, city of New York, January 20.

This diving dress is in most points like several others in its general aspect and construction; the principal improvement consisting in the employment of a larger portion than usual of metallic cylinders, in combination with the flexible water proof material, the more effectually to protect the limbs and other parts from injury. The claims are "*first*, the peculiar construction of the body piece, with its appurtenances of the pipes and chambers, as described. *Secondly*, the joint of the arms and legs, as made of spiral or circular wires, or hoops, covered with india rubber cloth, or other substance impermeable to water. *Thirdly*, the mode in which water proof covering, constituting part of the joints, is connected and secured to the cylindrical pieces of the arms and legs, by means of flanches upon said pieces, and a seizing of copper wire, or other fastening."

There is a pipe for conveying air down by means of a force pump, and another pipe from which the air respired is discharged. We cannot pretend to run a parallel between this and the numerous other similar apparatus of which we have some knowledge, not having seen a practical trial of the others; but on a late visit to New York, the above described machine was in actual use; the diver remained under water for about three-fourths of an hour, suffering, apparently, but little inconvenience during that time; he moved about with perfect facility, and passed into water of different depths sending up various articles from the bottom. We know that in all this there was not any thing of actual novelty, but it is mentioned because it tested the particular apparatus of which we have been speaking, and so far as the trial went it was perfectly satisfactory.

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34. For an improved *Cooking Stove;* Horace V. Teall, Canajoharie, Montgomery county, New York, January 20.

There is no very characteristic feature in this stove; the claim is to "the construction of a partition enclosing the two large holes for boilers, with the valves, or dampers," which we do not think it worth while to describe.

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35. For improvements in the construction of *Bee Houses and Bee Hives*, and the arrangement thereof; John Searle, Franklin, Merrimack county, New Hampshire, January 20.

The specification of this patent contains a system of management, and

a plan for the construction of the houses of bees, much in detail, and accompanied by various graphic illustrations. The claims made are to the construction of a spout, a balcony and its appendages, a ventilator, a feeder, a double top to the hive, and a cement floor to the house; all of which are fully described, and in a manner evincing a knowledge of the subject. The whole, however, is too intricate for a brief description.

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36. For an improved *Corset Truss for Ruptures;* John Oberhauser, city of Charleston, South Carolina, January 20.

The claims under this patent are to "the construction of a corset truss, under its various modifications as described; which shall sustain the muscles of the abdomen by the action of the steel spring, or springs, which surround the body, as contradistinguished from the support by bandages which have been frequently resorted to, which springs are widened out by stiff plates, capable of receiving and applying two or more pads to the ruptured parts, in the manner set forth."

A general idea of the mode of construction may be formed from the foregoing claims; this system of forming trusses, like most others, will afford advantages in certain cases, but it still presents but little of peculiarity, or of addition to the resources of the surgeon.

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37. For a machine for *Cutting Heading for Casks;* Lee Wells, Hartsville, Onondaga county, New York, January 20.

This is said to be an improvement on George Parke's machine, to which we shall not take time to refer. The heading, it appears, is to be cut by a knife, and the claim is to "the construction of the knife gate, as described," which description is not very luminous.

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38. For an improvement in the *Horizontal Wind Mill;* William L. Thomas, and J. Lewis, city of Boston, January 27.

The claim made in this horizontal wind mill is to "the manner in which the opening and closing of the wings is effected, as described." The wings are represented as in the same shape with those of the ordinary vertical sails; the devices used for turning the sails consist in causing their inner ends to be acted upon by what is called a double inclined plane, the inclination of which causes then alternately to present their edges and sides to the wind. To lessen the friction incident to this mode of turning them by the inclined guide piece, friction rollers are used. At their outer extremities the sails are braced together, so as to give them the requisite stability.

We very much doubt the success of this plan, and apprehend that it will not be found equal to the ordinary mill with vertical sails. The mode of turning the sails will produce considerable and constant friction, in spite of the friction wheels, and will, we apprehend, be very liable to derangement from this cause.

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39. For a machine for *Heading Spikes and Nails;* Reneer Dare, Bridgeton, Cumberland county, New Jersey, January 27.

The pieces of nail rod, cut into lengths, are to be pointed by the hammer

in the ordinary way. The heading machine has two jaws, operating like those of the blacksmith's vice, and in these are fixed dies adapted to the shank of the nail or spike, which is to be placed in them, and the head formed by a hammer. The jaws are opened and closed, and the nail inserted and discharged in a manner described in the specification, and the claim is to "the method of holding up and discharging the nail or spike in the dies, for the formation of the head, and upset of the same." We are somewhat at a loss to discover the real value of the machine, as it seems to us that some of those which perform the whole operation of spike making, do it effectually, producing good work with much greater rapidity than can possibly be done with that before us.

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40. For a *Spark Extinguisher*, for Locomotives, &c.; Timothy Newhall, jr. Lynn, Essex county, Massachusetts, January 27.

The sparks are to be carried into the chimney, through a tube which is recurved after it enters it, so as to have its mouth downwards. Below this opening there is a box, or trough, to contain water, into which the sparks are to be driven by the force of the draught. To prevent the waste of water, and the return of the sparks, the mouth of the tube above spoken of, is furnished with what is called a conical funnel, and upon this, it appears, the utility of the apparatus depends. It is obscurely explained, and we really do not understand in what way it is to produce the contemplated effect; with the claim, therefore we dismiss the matter.

"What I claim as my invention, and desire to secure by Letters Patent, is the manner of applying the conical funnel for the purpose of preventing the waste of water; and this I claim in combination with the other parts of the apparatus with which it is connected, substantially in the manner set forth."

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41. For improvements in the *Machine for Cutting Lagging;* Benjamin B. Slade, Smithfield, Providence county, Rhode Island, January 27.

The stoves, or slats, which constitute the peripheries of the drums, or cylinders, used in cotton, or other, factories, is denominated lagging, and the undersides of these are to be cut concave in a degree corresponding with the size of the drum, or cylinder, of which they are to constitute a part. The intention of this machine is to cut every required size of curve by means of the same rotary cutters, which are affixed to the periphery of a revolving wheel, and cut crosswise of the stuff. It will be manifest that if such wheel is of the size due to the smallest curve, by passing the lagging over it, at right angles with its plane, the desired curve will be obtained; that if the cutters project over the edge of such wheel, and the stuff be passed over its face, the cutters would traverse its surface, and cut, or plane it flat; and it will be equally manifest that by presenting the lagging at the various inclinations between these two, every intermediate curvature will be obtained; this is the principle of action, and the following is the claim.

"What I claim as my own invention and desire to secure by letters patent is the platform hanging on swivels, and the slide gauge on the top of said platform, in combination with the rotary cutters; the whole constituting a *lagging machine* for cutting different sized circles with the same cutters, all constructed substantially as above described."

42. For a machine for *cutting or mincing Vegetables, Meat, and other substances;* John G. Conser, Rebersburg, Centre county, Pennsylvania, January 27.

This machine consists of a cylinder having knives set round its periphery, and revolving horizontally in a hollow cylinder, or concave, furnished with similar knives. These knives are placed obliquely, so as to give to the articles operated on, a progressive motion from the feeding towards the discharging end. The feeding is performed by means of a hopper on the upper side of the cylinder, at one of its ends. The claim is to "the arrangement of the knives, or cutters, on the cylinder, as before described; but no other part of the machine is claimed."

Specifications of American Patents.

Specification of a patent for an improved Parlour Stove; granted to Jordan L. Mott, *city of New York, December 7th,* 1837.

To all whom it may concern, be it known, that I, Jordan L. Mott, of the city of New York, have invented an improved parlour stove, which is furnished with air-heaters, so constructed as to economize fuel, and to supply air of genial warmth, which is not deteriorated in its passage through the heating flues. And I do hereby declare that the following is a full and exact description thereof.

Fig. 1.

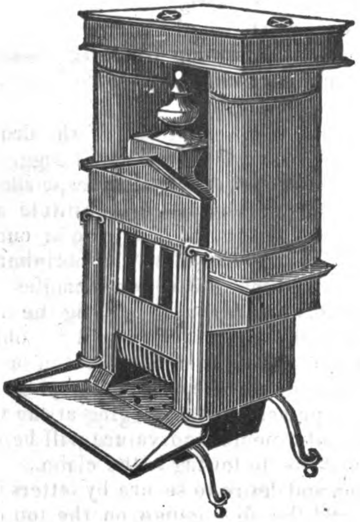


Fig. 2.

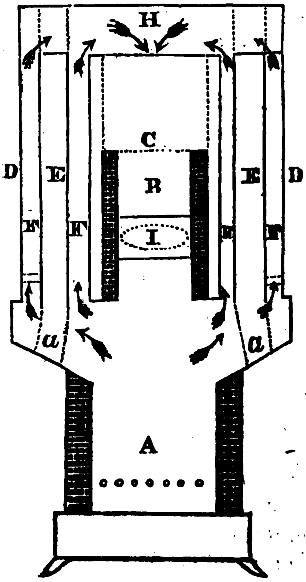


Fig. 3.

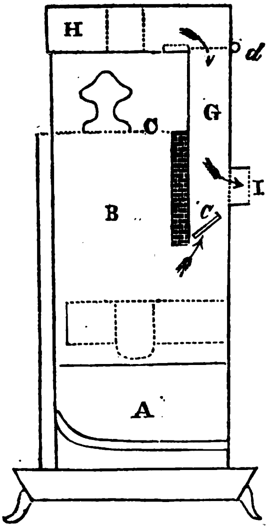


Fig. 5.

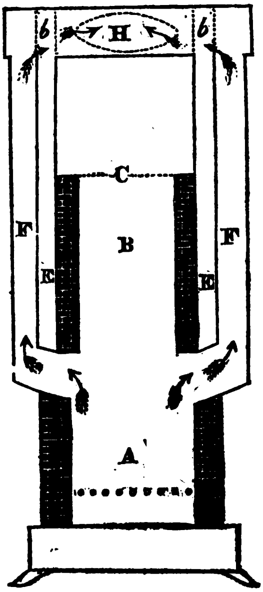


Fig. 4.

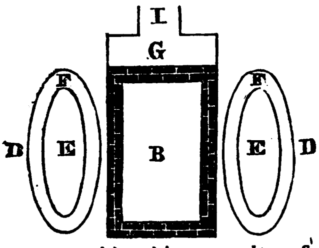


Fig. 1. in the accompanying drawing, is a perspective view of the stove. Fig. 2, is a vertical section through the middle thereof, parallel with its front; and Fig. 3, is a vertical section from front to back, through the middle.

In each of the figures, like parts are designated by the same letters of reference.

A, is the grate, or fire chamber, which is surmounted by B, a reservoir for coal, which has a close fitting cover at C, allowing a considerable quantity of fuel to be supplied at once, and to burn out gradually. D, D, are the combined flues, and air heaters, consisting of one cylinder, or rather oval tube, or chamber, within another, the innermost being the air chamber, and the space between it and the outermost the smoke flue. E, E, Fig. 2, &c., are sections of the inner, or air, flues, and F, F, the spaces surrounding them, and forming the smoke flues. Air is admitted into the interior, or air, flue, at its lower end, through tubes, or apertures, leading into it, in any convenient way, as at the part represented by the dotted lines *a, a*; these tubes, or apertures, may be extended, if preferred, so as to admit air from without the room, but this will seldom be found necessary. The air which is heated in passing through these tubes, escapes into the room through openings at *b, b*, in the top of the stove.

The direction of the draught, or passage, for smoke and heated air, from the fires, is represented by arrows. There are, as in many other stoves, two directions for the escape of the smoke, &c., one directly to the escape pipe, and the other by a more circuitous route, which is to be used after

the fuel has become perfectly ignited. There is a flat flue, G, extending up from the fire-place to the chamber H, at the top of the stove; in this flat flue, there are two valves, or dampers, *c*, and *d*, by which the draught is governed. L, is the escape pipe for smoke, and into which it passes directly, when *c* is opened, and *d* closed; but when these valves are reversed, the draught is carried through the flues surrounding the air-tubes, and down the flue G, to the escape pipe. Fig. 4, is a horizontal section of the stove at the level of the escape pipe, the parts of which figure are designated by their proper letters of reference. By this arrangement of the flues, and of the air-tubes within them, the exterior, or shell, of the stove is directly heated by the heated air, and a free radiation takes place into the room. Fig. 5, shows a modification of this stove, in which the smoke flues do not entirely surround the air-flues, the latter being heated directly, on the side towards the reservoir B, but still through the intermedium of the brick lining, which, wherever it is represented, is coloured red. In other respects, the construction of this stove is identical with that before described.

Having thus fully shown the manner in which I construct and arrange the several parts of this stove, it is to be distinctly understood that I do not intend to claim these individual parts, generally, as my invention, they having been previously known and used.

All that I claim as new, and for which I ask Letters Patent, is the air chambers, or tubes, surrounded in whole, or in part, by the smoke flues, in the manner, and located, as herein described, in combination with the side openings, or apertures, that connect the smoke flue F, F, with the fire-chamber, whether said openings be under, or above, the surface of the fuel; and this I claim whether combined with a stove, such as that herein represented, or with one of any other construction, to which such side flues, so arranged and combined, can be advantageously appended. It being further understood that I make no claim to air-tubes surrounded by the smoke flues, when placed immediately above the fire chamber.

JORDAN L. MOTT.

Progress of Practical and Theoretical Mechanics and Chemistry.

On the fallacies of the Rotary Steam Engine; by JOHN SCOTT RUSSELL, Esq., M. A., F. R. S., Ed.

The principles of the Rotary Steam Engine have been frequently adverted to in this Journal, and opinions indicating a want of confidence in them, (v. particularly Vol. XVII, p. 173) freely expressed by the editor. The Engine still continues to maintain its ground, and its claims to be put forth as a construction, preferable, especially for light work, in point of cheapness and efficiency, to that of the reciprocating engine. The motives for its adoption, with those who attempt to theorize upon it, are to get clear of the *loss of power* occasioned by the use of the crank and by the constant check which the piston undergoes from the necessity of its reverse or reciprocating movement. On these two points there have been much philosophical discussion, and much laboured and learned and unlearned disputation. Avery's Rotary Engine has been lately introduced into Scotland and its capacities highly extolled in some of the Journals. This has called forth several

learned papers in opposition to the objections to the reciprocating engine,—unfavorable to the rotary principle, and explanatory of the true doctrines of motive power and mechanical action.

The writer of the paper, an abstract of which is here given, enters with learning and research upon this interesting topic. His essay may be found at length in Jameson's Journal, vol. XXIV, p. 35, and an abridgement of it in the London Mechanics' Magazine, No. 776, p. 192. G.

Mr. Russel states:—"I have had the opportunity of examining and working the most successful engines of this kind ever produced, and therefore conclude that, had theory never led me to any such result *a priori*, I must have been convinced that practical experience was opposed to the rotary construction of the steam-engine. In what follows I shall endeavor to adduce my arguments in a form as little technical, as is consistent with precision.

1. It is first of all my wish to show that the subject of the rotary steam-engine is *not so new and untried* an invention as some who attempt the problem for the first time may be led to imagine;—for this purpose I adduce the names of more than ninety inventors, most of them patentees.

2. By an arrangement of these inventions, I have endeavored to show that *five different classes comprehend them all*, and that the others are mere repetitions of the same principle, and attended with the same failure; so that an inventor may know whether his invention contains an entirely new principle, and if it do not, that it has been already tried and failed.

3. By showing in one view, the names of inventors of unsuccessful rotary engines, I endeavor to convince the inventor that five classes already invented have *not failed from want of genius, skill, or practical experience*, in those who have made the trial, for the list contains the names of eminent practical men.

4. I endeavor to show that the *ordinary crank engine does not possess the defects attributed to it*, and which it is the sole object of the rotary engine to remedy,—that the use of the crank causes no loss of power.

5. In a practical point of view, the *rotary engine is every way inferior* to the reciprocating engine;—in simplicity, and cheapness, and ease of construction,—in durability and economy in use,—in uniformity of action and equable motion.

6. The rotary engine is *peculiarly inapplicable to the great purposes* of terrestrial locomotion and steam navigation—objects to which it has been considered peculiarly suitable.

7. That the *present steam-engine is practically perfect* as a working machine, being within ten per cent. of mathematical perfection.

8. That the *crank* of the common steam-engine possesses certain *remarkable properties* of adaptation to the nature of matter, of motion, of steam, and the human mind; from which its supremacy as an elementary machine is derived,—properties which cannot possibly belong to any species of rotary engine.

Rotary engines may be arranged according to the mode of action into four classes.

Class I.—Rotary engines of simple emission.

Class II.—Rotary engines of medial effect.

Class III.—Rotary engines of hydrostatical re-action.

Class IV.—Rotary engines of the revolving piston. As closely connect-

ed with the rotary engines in the fallacy which has given rise to both of them, we may add a series of inventions forming,

Class V.—Revolving mechanism substituted for the crank.

Class I.—The rotary engine of simple emission forms the earliest, as well as the most rude and elementary method of giving motion to mechanism, by the escape of vapour or steam. It is described by Hero of Alexandria, in his *Pneumatika*, upwards of 120 years before Christ, and depends, for its effect, upon the same principle which gives to a rocket its career, and makes a fire-wheel revolve in giving off its beautiful lights. In these, as in all instances where fire, or steam, or any fluid or gas is generated in a chamber from which it is permitted to issue with violence, it will, in its exit, drive the vessel from which it issues away from it in the opposite direction, and is, in fact, merely an application of the principle of recoil,—where the gas, generated by the explosion of the powder, urges the ball outwards in one direction, and forces the breech of the gun backwards in the opposite one. The same recoil is felt in all cases of simple emission of a fluid from a reservoir; and if it be so arranged that water, steam, air, or the gaseous productions of gunpowder, shall rush out of a chamber through the arms of a revolving wheel, the openings of escape being properly directed, the recoil will urge round the wheel, and we shall have a revolving engine of simple emission. By availing himself of this principle, the mechanist of Alexandria produced an efficient engine, merely by heating a vessel containing water and air, and allowing the vapour to rush from the two opposite orifices at the end of two arms proceeding from a sphere which the emission was employed to move.

Instead of using the principle of recoil, the force of steam issuing with violence as we see it from the mouth of a kettle or boiler, may be directed upon the vanes of a wheel, so as to blow them round; and thus we have a second variety in the manner of converting the simple issue of steam into a moving power. This second species of the rotary steam-engine of a simple emission was invented by Branca, in 1629.

Since that time the engines of this class have been frequently re-invented and slightly modified.

Inventors of Rotary Steam-Engines of the First Class.

1.	Hero of Alexandria,	B. C.	130
2.	Branca,	A. D.	1629
3.	Kircher,	"	1643
4.	Daslesme,	"	1699
5.	Kempel,	"	1785
6.	James Sadler,	"	1791
7.	Richard Trevithic,	"	1813
8.	Alexander Craig,	"	1834

The theory of machines of simple emission has been frequently and fully investigated, and the result is, that there is no possibility of obtaining, by simple emission, more than one-half of the whole power of the steam, so as to make it available to useful mechanical effect. The other half is wasted in giving off its impulsion to the air, or is expended in a current equally unavailing.

Practical experience corroborates the predictions of theory. Smeaton and Pelletan made the machines of simple issue the subject of careful experiment, and found that 3 parts out of 11, 8 parts out of 27, and 2 parts out of

5, are the highest measures of practical effect, that it has been found practicable to attain, and by no possible improvement can more than one-half of the whole power be turned to a useful effect.

Class II.—Rotary engines of medial effect are those which do not immediately give revolution to an axis by the action of steam upon the wheel, but have a *medium of communication* between the power and the effect, which medium is the direct agent in circular motion. This class of engines will be well understood by taking as its type any simple steam machine, such as Savary's and Newcomen's, used for raising water, which water by falling on the floats of a common mill wheel will then give rotary motion to it. The engine of Savary raises water by pressing directly on its surface, and it is only necessary to allow this water to fall on a wheel, when it will be made to revolve and form an engine of the 2nd class.

A variety of this class has been invented of which the fire-wheel of Amontons is a type. The stream pushes water through certain channels that form the arms of the wheel, from a set of chambers on one side of the wheel, to a corresponding set of chambers on the opposite; and thus the side filled with water preponderates over the other, and the wheel revolves The water being constantly driven off by the steam from a given side of the wheel to that opposite, uniform revolution is the result of the weight of the water. In this state, although steam is the agent, water is the medium of communicating the rotary motion.

Solids have also been made the medium of effecting rotation in this manner; weights of solid matter, in the form of pistons, have been transferred by the force of steam to a considerable distance from the centre on one side of a wheel; and drawn nearer to it on the other side, so as, by bringing about a continual preponderance on one side, to effect a revolution. Watt and Witty have designed rotative mechanism of this nature.

Inventors of Rotary Steam-Engines of the Second Class.

1.	Guillaume Amontons,	A. D.	1699
2.	Leopold of Plainitz,	"	1723
3.	Champion of Bristol,	"	1752
4.	James Watt,	"	1769
5.	Davidson & Hawkesley,	"	1793
6.	Richard Witty,	"	1810
7.	Sir W. Congreve,	"	1818
8.	John Moore,	"	1820
9.	Sir W. Congreve,	"	1821
10.	Thomas Masterman,	"	1822

In this class of engines the loss of effect is manifest, for it is necessary that the steam, in order to produce circular motion, shall give out its force in setting the medium in motion, and, in overcoming the very great resistance of the liquid in all the pipes, passages, and valves, through which it is transmitted to alternate sides of the wheel in every revolution; the whole of this force is subtracted from useful effect, and becomes power lost.

In those which move weights, from and towards, the circumference, there are mere groups of reciprocating pistons without cranks, and share the evils to be explained in Class V; in fact, in the engines of Watt and Witty of this class, we have *a series* of reciprocating engines ranged round a wheel to do the work of one.

In the case of the fluid medium, we have not only a loss of all the power expended in moving the medium itself, but also the additional loss of effect

encountered in all modes hitherto adopted for applying a fluid to the rotation of a wheel, a loss, in the best examples ever presented, amounting of itself to more than one-sixth part of the power.

Class III.—The engine of hydrostatical re-action is more effective than either of the former classes. As invented by Watt in 1769, it consisted of steam-vessels in the form of hollow rings, or circular channels, with proper inlets and outlets for the steam, mounted on horizontal axles, like the wheels and buckets of a water-mill, and wholly immersed in some fluid. This wheel was made of iron, six feet in diameter, and the re-action of mercury was employed to give revolution to it; the engine moved, but was found to be inefficient, and abandoned, although it has been tried in very favorable circumstances.

The principle of action is this: steam is admitted into a circular channel or chamber on the circumference of a wheel; this chamber is partially filled with some liquid, the pressure of the steam is expended in pushing the mercury in one direction, and the end of the chamber in the opposite way, so that while the liquid is thus forced out of the chamber, the chamber is by an equal force pushed away from the liquid; the wheel is thus turned round.

It is apparent that a part of the force is employed in propelling the wheel, and the remainder is expended in overcoming the resistance of the liquid of re-action, and expelling it from the chambers, which remainder is a large portion of the power withdrawn from useful effect.

Inventors of Rotary Steam-Engines of the Third Class.

James Watt, ...	A. D. 1782
Bryan Donkin, ...	" 1803

Class IV.—Rotary Engines, having a revolving piston, are constructed on a much better principle, and hold out much fairer prospects of a successful competition with those having the ordinary reciprocating piston, than any of the species of the three first classes that have been already considered. In these classes the steam is not confined in rigid vessels, but its action is applied to producing currents in fluids, and force is expended in medial effects which are useless, and therefore waste power. This is not the case with the steam-engine of the revolving piston. The steam is confined in a close and rigid chamber, and acts only on a solid inflexible surface, and makes its escape by confined passages, so that its full effect may be obtained in useful work. Abstractedly considered, it is an engine capable of giving out the full power of the steam, and therefore may fairly be imagined to come into competition with the ordinary reciprocating crank engine. The objections to it are entirely of a practical nature, and regard the engine not in its abstract mathematical form, but as a machine made of destructible matter, of matter imperfectly elastic, of surfaces opposing resistance to motion, of matter obeying the known laws of motion and rest. These objections are not the less valid that they are of a sensible and tangible, rather than a speculative description. But as a natural consequence of the more plausible deceptions held out by this species than by any of the three preceding ones, it has followed, that the fallacies of this class have been more widely seductive than any of the others. The Patent-office presents us with the names of more than forty victims, including some of the highest fame.

Inventors of Rotary Steam-Engines of the Fourth Class.

		A. D.			A. D.
1.	James Watt,	1782	24.	Robert Delap,	1821
2.	James Cooke,	1787	25.	Bambridge & Thayer,	1821
3.	Bramah & Dickinson,	1790	26.	William Foreman,	1824
4.	Edmund Cartwright,	1797	27.	Lord Cochrane,	1825
5.	Jonathan Hornblower,	1805	28.	L. M. Wright,	1826
6.	William Murdoch,	1805	29.	F. Halliday,	1825
7.	Jonathan Hornblower,	1805	30.	Joseph Eve,	1825
8.	John Trotter,	1805	31.	John Costigin,	1826
9.	Andrew Flint,	1805	32.	Marquis de Combis	1826
10.	William Lester,	1806	33.	Elijah Galloway,	1826
11.	Richard Wilcox,	1806	34.	Paul Steenstrup,	1827
12.	Thomas Read,	1808	35.	John Evans,	1828
13.	Edward Jane,	1808	36.	John Strut,	1830
14.	Samuel Clegg,	1809	37.	E. & J. Dakeigne,	1830
15.	William Chapman,	1810	38.	William Morgan,	1831
16.	John Trotter,	1811	39.	Samuel Hobday,	1831
17.	William Onions,	1811	40.	John Erricson,	1832
18.	Richard Thevitic,	1813	41.	Robert Stein,	1833
19.	Joseph Turner,	1816	42.	Elijah Galloway,	1834
20.	John Mallam,	1818	43.	Edward Appleby,	1835
21.	Joshua Routledge,	1818	44.	John F. Kingston,	1835
22.	William Carter,	1818	45.	John Yule,	1836
23.	John Rider,	1820	46.	John White,	1836

The fallacy of this class of engines we shall expose in conjunction with the next class, as the same misconceptions lie to a considerable extent at the door of both.

Class V.—Revolving mechanism substituted for the crank of the common steam-engine, for the purpose of obtaining from the reciprocating piston a rotary effect otherwise than by the crank, and in a better manner than by the crank, forms a class of inventions involving fallacies similar to those in which the revolving piston has originated. These two may therefore be considered together.

Inventors of Rotary Mechanism as a substitute for the crank.

		A. D.			A. D.
1.	Jonathan Hulls,	1737	13.	Edmund Cartwright,	1801
2.	Keane Fitzgerald,	1757	14.	Matthew Murray,	1802
3.	Gautier of Nancy,	1757	15.	Richard Witty,	1811
4.	John Stewart,	1769	16.	J. Dawes,	1816
5.	Dugald Clarke,	1769	17.	Tobias Mitchell,	1810
6.	Matthew Washborough,	1779	18.	Henry Penneck,	1827
7.	James Watt,	1781	19.	William Aldersey,	1821
8.	Thomas Burgess,	1789	20.	Robert Barlow,	1827
9.	Matthew Murray,	1779	21.	Thomas Peck,	1827
10.	William Lander,	1799	22.	Samuel Clegg,	1828
11.	Phineas Crowther,	1800	23.	William Lucy,	1836
12.	George Medhurst,	1801	24.	Charles Schafhautl,	1836

Although the name of Watt has been included in this list of inventors of substitutes for the crank, it should be observed, that he was only driven to the invention of such a substitute by the circumstance of a patent having been previously obtained for the crank in its simple form, and that he aban-

doned this beautiful, but more complex, mechanism on the instant that the elementary crank was released from the fetters of monopoly.

After combating with much demonstrative force the erroneous opinion of great loss of power by the crank, the author proceeds:

"In the reciprocating piston, therefore, acting through the crank, the whole power is found by multiplying the stroke and back-stroke, or twice the stroke of the piston, by the pressure upon it, and this is equivalent to the whole effect produced in the entire revolution of the crank; the pressure of the steam, and the space it moves through, are therefore the measure of the power.

In the revolving piston, the effect of the steam must be precisely the same, if the revolving piston be of the same size, and moves through the same space as the reciprocating piston; and if the revolving piston have a pressure on it equal to the mean pressure on the crank, and move through a circle equal to the circle of the crank, the effect will be the same in both cases.

Since there is no loss incurred by propagating the action of the steam on a reciprocating piston through the crank of a revolving axle, and since it is not in the power of machinery of any kind to augment the quantity of power given out by any mover, but merely to arrange, dispose, and modify that power to suit any given purpose, it follows that the rotary piston can have no purpose to accomplish, unless it excel the reciprocating one in simplicity and economy of construction, diminished bulk, durability, and economy in operation, facility of repair when deranged, diminished friction, or a peculiarity of adaptation to some individual purpose, such as steam navigation or inland transport.

I. As regards simplicity of parts, the engine with the rotary piston cannot excel the simplest forms of the reciprocating engine; take, for example, that form which merely consists of a cylinder, piston, and crank axle; where the cylinder, mounted on an axle, oscillates with the revolutions of the crank, which is immediately attached to the end of the piston rod, and which requires no moving valves of any kind, the steam being admitted and emitted through ports in the axle of the cylinder, which open and shut by the motion of the cylinder itself. Neither as regards facility and economy of construction does it possess superiority; for it will be readily granted to me, that whether the piston and channel in which it moves be rectangular or circular, they are more difficult of construction than a straight, round cylinder and piston, which being derived from the straight line and circle, are the simplest of forms, while an annular chamber, if the piston be rotary, is a surface of double curvature, of difficult construction and imperfect completion; if square, the construction of a rectangular piston is a still more troublesome attempt, the increased surface being increased expense and labor.

II. In point of bulk, the common reciprocating piston has a decided advantage; the annular cylinder of the revolving piston must be (to give equal power) about two-thirds of the area, and about three times the length of the reciprocating cylinder, being a bulk of cylinder nearly double. But even this is an estimate too favourable to the piston of rotation; the diameter of the axle requires to be very considerable; there are various reasons for this,—one is, that it is frequently a steam passage; another is that it is much larger than is required for the mere purpose of communicating the force; because any force of steam applied near the centre is of little value in pro-

ducing an effect, from the smallness of the circle which that part of the piston describes; and for this reason also, that the portion of piston exposed to leakage and wear is in proportion to the effect gained; the piston is therefore removed to a considerable distance from the centre, to answer the purpose, likewise, of rendering the revolution of the parts more nearly equal. These points will, however, have our attention at another time; it is sufficient for our present purpose, that these circumstances render it imperative to increase the bulk of the engine.

III. In point of durability and economy in its use, the most conclusive arguments lie against the rotary engine. I have seen many of them perfectly constructed, working beautifully, but they went very soon out of order. They invariably work best when new. This may appear to some to arise only from the defects incidental to particular modes of construction. I admit that many have had peculiar elements in their construction not indispensable to the principle. But, on the other hand, I shall now go on to show, that, independent of the idiosyncrasy of peculiar engines, the necessary mode of action involves elements of self-destruction very rapid in their operation, by means of which every rotary piston must soon wear itself out of condition.

It is a received principle in constructing machines, that, in a good engine, the parts should wear equally, and that even the very working of their parts should make them fit each other better. This is truly the case with the piston and cylinder, and other appendages of the reciprocating steam-engine. So true, that old engines of Messrs. Watt and Bolton—some of their earliest—are still working better than they ever did, or than some more recently made. To this the reciprocating engine necessarily presents a contrast: and it will not be difficult to show that its parts *must* wear unequally, so as to become unfit for use, and be rendered by each day's work less fit for the duty of the succeeding one.

To show the cause of this:—Suppose two perfectly flat plates of metal, perfectly round, to be laid one upon the other, so as exactly to coincide at every point. Let the undermost rest upon a table, and let the uppermost be made so as to turn round on an axis while in contact with the other, and let a rapid motion be communicated to the uppermost,—let me ask what will be the result of the attrition of the one of these upon the other? Will they wear equally, so as to remain in a state of mutual adaptation, or will they not? Experience furnishes an answer which exactly quadrates with reasonable expectation;—they will *not* wear equally,—they will *not* retain their forms. Let it be considered that the outer edge performs a larger circuit than any part nearer the centre; that, therefore, as all the parts revolve in the same time, those nearer the circumference move with a greater velocity than those towards the centre; that the attrition is more rapid at the circumference, and uniformly diminishes towards the centre of the plates; then it invariably follows that *the plates must become conical*, with a continual tendency to become more so. This is a most incontestible truth. It is one which has caused the failure of many beautiful inventions; it is the reason why conical bearings have been universally abandoned for cylindrical ones; and it is the cause that has rendered a most beautiful class of inventions totally useless to the improvement of the reciprocating engine. I allude to the flat *revolving valve* introduced by Oliver Evans, and afterwards brought into this country, but now universally abandoned, in spite of simplicity, efficiency, and economy, on account of this very attrition from a centre which we consider to be ruinous to every steam engine on a revolving principle.

The application of the result of this illustrative experiment to the subject in question, is abundantly obvious, the circumstance of rotation from a centre, with pressure on bearing surfaces of which the parts are at unequal distances from the centre, implies the excessive attrition of the circumferential surfaces above those which are near the centre, and which move with less velocity. Hence the circumferential surfaces wear more rapidly, and are unfit for use long before the central parts have suffered by any sensible effect. Where extensive metallic surfaces are in contact, their repair is a matter of much expense and delay.

To diminish this cause, or to delay its effect, the revolving piston is removed far from the centre of action. By this means, however, the bulk of the machine, and its friction, are very much increased, and the evil only partially remedied. It is obvious, however, that in this way, by increasing the radius, the engine is brought more nearly to the principle of the straight cylinder; so that perfection would just be attained if the circular cylinder were made straight, or, in other words, if the rotary engine were converted into an ordinary reciprocating engine.

When a piston reciprocates in a straight cylinder, all its points, and those of the cylinder, move equally, being in lines parallel to the axis; and to prevent accumulation of eccentricity, the piston may have its position on the circumference altered by part of a turn.

The essential nature of *rotary attrition* is therefore fatal to the success of the revolving principle,—a cause of expensive repairs, and speedy destruction.

IV. There are other defects to which this species of engine is peculiarly liable;—to vacuities and losses at the valves and passages—to irregular action, and collisions and shocks from the action of the parts one upon another; but these will be the subject of consideration as they occur in individual machines.

V. Unless, therefore, we shall find that there is some peculiar applicability in this form of engine above the common one, to certain important purposes, such as steam navigation and inland transport, we must abandon the hope of deriving practical advantage from the engine of rotation.

Now, it has been proposed for steam navigation, but to this it is peculiarly inapplicable. In a steam-vessel, it is useful to have the axis of rotation as *high*, and the weight of the engine as *low* as possible. Now, if the engine be placed on this axis, as it would be in the case of the rotary engine, one of two evils would follow; the axis would require to be much lowered, or the weight of the engine would be so high as to make the vessel the very reverse of steady. By such a disposition of its parts it must necessarily be rendered crank, and have its power greatly diminished. In the present engine, the weight is immediately above the floor of the vessel, and the axis in contact with the deck.

Applied directly to the axis of the steam-carriage or locomotive engine, there are insuperable objections to the rotary engine. As there would be no spring between it and the wheels, every jolt would derange the machinery. The weight of the engine, rigidly connected to the axle, would reciprocate the evil, and knock the wheels to pieces. These evils are prevented in the reciprocating engine, by the detachment of the engine from the axle, and the propagation of power through rods, wheels, or chains, to the propelling wheel or axis. It is indeed a radical defect in some of the existing forms of the locomotive engine, that the detachment is less perfect than might be desired. This very adjustment, so impracticable with the rotary engine,

was, even with the superior facilities presented by the form of reciprocating locomotion, one of the greatest impediments to the success of elemental locomotion.

VI. In addition to the above-mentioned advantages possessed by the reciprocating engine above the rotary one, it presents facilities (altogether wanting to the latter) for working directly the subordinate appendages of the steam-engine, such as cold water pump, its own feeding pump, &c. If the engine be a condenser, the simplicity of the reciprocating mechanism of the air-pump puts the rotary engine altogether *hors du combat*.

VII. All these considerations, of the most important practical bearing, demonstrate clearly to us, that if there be no very considerable loss of power in the reciprocating engine, we have little inducement to make the substitute of the rotary chamber and revolving piston for the cylinder and reciprocating piston.

It appears, on the contrary, both from theory and practical working of the steam-engine of ordinary construction, that, with a very small allowance for friction, the piston gives out through the crank, in actual work done, all the power of all the steam applied to it in the cylinder. Mechanism can do no more. And since neither simplicity of action, compactness of form, condensation of bulk, nor economy, either in the first cost or operation, gives it a superiority to the common engine, but that, on the other hand, from the very nature of its movement, it possesses the elements of rapid detrition and unequal deterioration, and is, by the necessary arrangement of its parts, rendered peculiarly inapplicable to such important objects as the purposes of steam navigation and land transport, I do not see what motive can possibly remain for devoting a single thought to its further improvement, or the alteration of its form, when its very principle holds out no higher premium than that, if brought to its utmost perfection, it might possibly approach in durability and efficiency the ordinary reciprocating engine, but in no point of view could ever excel it. To expend more time and mind on such a subject, is therefore merely sowing the wind to reap the whirlwind.

VIII. The force of the exposure I have now been induced to make of the fallacious nature of those attractions by which the rotary motion has drawn aside ingenious mechanists from the direct path of legitimate invention into the fruitless pursuit after ingenious trifles, will have considerable weight added to it, if we turn our attention to the *peculiarities of the crank*, as one of the elementary machines for the conversion of reciprocating into rotary action.

The crank, as the means of converting the reciprocation of the piston of a steam engine into a continuous rotary action, possesses singular and beautiful properties, which distinguish it from every other means of producing that conversion, and which appear to be so perfectly adapted to the nature of steam and the constitution of solid matter, that we are indebted to it materially, although indirectly, for the very great advantages we derive from the modern steam-engine as a source of mechanical power. Ingenuity has been taxed to the utmost to find substitutes for it, which should remedy the (imaginary) defects of the crank, but the mighty element has disdained them all, pounded them to powder, and thrown them from her. Like unskilful keepers, they have attempted to control a power by means which have only encountered the force they were designed to direct; and, after many vain efforts, it is found that the crank is the magic rod under which alone the mighty force of the element becomes peaceful and docile. Wheels, sectors, and racks, in various combinations have been made to as-

sume the functions of the crank, but they have uniformly been declared incapable. Once or twice it has happened that a substitute was obtained, but it was soon found that these (the sun and planet motion, for example,) were only cranks in disguise; and the useless mask was speedily dispensed with when the cause of its assumption had ceased to exist. It was an invidious patent alone that induced the immortal Watt to give the name of sun and planet to two wheels, placed one at the base and the other at the apex of the crank. The disguise appeared as the patent expired, and the simple unencumbered crank resumed its well-merited station.

The peculiarities of the crank which give it its unapproachable perfection as an elementary machine, I shall now go on to describe.

1st. I would observe, that in the reciprocating piston of a steam-engine the following things occur :—The piston is to be put in motion in one direction, then stopped; then put in motion in the opposite direction; stopped again; motion in the original direction once more begun and made to cease. At the commencement of the motion downward, a valve is to be opened for the entrance of the steam above the piston, which valve must be closed at the end of the stroke, and at the same instant in which one steam-valve closes, an opposite one must be opened to admit steam below the piston; at the same instant, also, a valve of eduction for the first portion of the steam must be opened, and a second valve of emission on the opposite side of the piston closed. At one and the same instant, therefore, the motion of the piston has to be stopped in one direction, and commenced in the opposite direction, one steam communication closed, a second opened, a third of eduction cut off, and a fourth renewed, and all this (for the perfection of the engine,) must be done with the most absolute precision.

But these processes, which produce the change of state from rest to motion, and from motion to rest, require time. Matter acquires momentum which must be gradually removed, otherwise that matter is subjected to concussion, as if by the stroke of the hammer, and either suffers or produces injury. And, on the other hand, when in motion, matter requires a force to stop it equal to the force that gives it that motion. These effects therefore, cannot be instantaneous;* and it is necessary that while the motion which the steam gives off be uniform and continuous, the parts of the engine itself shall be allowed time to be brought to a state of rest, without shock, concussion, or jolt, and as gradually and gently be again urged to their greatest velocity in the opposite direction. *All these with exquisite adjustment the crank effects;* it stops the piston as gently and softly as if it placed beneath it a cushion of eider down, and afterwards as gradually begins and accelerates its motion to its highest velocity in the opposite direction. The valves too, are opened with the same perfect adjustment, being performed with that gradual motion which proportions the largeness of the aperture to the supply of fluid required to be transmitted. An adjustment so complete could only take place by such a relation as subsists between the crank and piston, the one describing uniformly the circumference of a circle, while the other moves by simultaneous gradations of alternately increasing and diminishing extent. But this is not all that distinguishes the crank.

2d. It is one of the highest recommendations of a piece of mechanism, that any very slight error in its construction shall not very materially pre-

* "On sait que pression ne peut pas produire tout-à-coup une vitesse finie."—Lagrange, Mech. Analyt., p. ii. sec. x.

vent its usefulness; nor any slight derangement of its adjustment be attended with immediate destruction, but that on the other hand, the *efficiency of the mechanism shall be consistent with such degrees of correctness as ordinary workmen can accomplish, and with such care as ordinary attendants can be trusted to bestow;* also, that the process of disrepair shall be so gradual as to give timely warning of the necessary re-adjustment. Just such a piece of mechanism *is* the crank. It is at the top and bottom of the stroke, or in the line of the centres, as it is technically called, that the opening and shutting of the valves should take place; and it is just at this point that pressure on the piston can produce any effect on the crank; but suppose the valves not to open with absolute precision, suppose them to open and shut too soon or too late, then will the error at that part of the circuit be of comparatively small importance, because *just then*, the motion of the piston is so slight, that, through an arc of twenty degrees, it does not describe one hundredth part of a stroke, and the effect of any error in that space will not affect the crank by more than one hundredth part of its amount; any *error of adjustment is therefore diminished in effect to one hundredth part* of what would be produced, were the motion of the piston to be uniform in portions corresponding to the arc of description, as would be the case in any other species of rotary conversion.

3d. In like manner, errors arising out of construction, management, or wear, are diminished one hundred-fold by transmission through the crank. It has been to me a matter of frequent astonishment, that although I have seen at the mouths of coal-pits, small mines, and quarries, mere remnants of engines, frail rusty old fragments of iron and wood, working so loose as scarcely to remain upright upon their basements, they were still working within 30 per cent. of their full power.

4th. To all these circumstances, I may add, that the constitution of the crank is one reason why an engine may be constructed of enormous weight, and of the most unwieldy dimensions, without being thereby much injured in its working; because the crank acquires so slow a motion at the commencement and termination of the stroke, that it equally slowly communicates motion to all parts of the machine, and in a like manner receives from them the impetus which they give out in the act of being again slowly brought to rest towards the end of the stroke. The impetus, therefore, given to the reciprocating parts of the machine is *lent* not *lost*.

We have thus endeavoured to expose the nature of the fallacy under which they labour, who imagine that the present steam-engine, as derived from Watt, is a machine which "destroys" or "absorbs" a larger portion of the power it is designed to transmit, and who look to the rotary engines as a means of increasing the amount of the power given out in useful effect. That the rotary engines, which appear day after day, are not new, we show from the fact, that the five great classes which comprehend them all have been invented and re-invented by upwards of ninety individuals. That their inventions have been unsuccessful, is manifest, from the non-existence of their machines in the daily use of ordinary manufactures. That the failure of these contrivances did not arise from defects accidental to the peculiar arrangements and contrivances of the engines, is rendered probable by the great variety of forms in which they have been re-invented, tried, and abandoned. That they have not failed from deficiences in the workmanship and practical details, is rendered still more probable by the circumstance of finding among the names of inventors, those of the most eminent practical engineers. We have next shown that in theory, the crank

of the steam-engine in common use, cannot, as has been supposed, be attended with a loss of power, as such loss would oppose the established doctrines of virtual velocities; it is shown also from very simple and elementary considerations, that what appears to be lost in force, is resumed in velocity—that, in proportion as the mean force on the piston is greater than the mean force on the crank, in that proportion is the space described by the latter greater than the space described by the former. That the dynamical effect produced in a given time is exactly in the proportion of the steam expended in that given time; and thus we have arrived at the conclusion, that the common reciprocating crank steam-engine has not the faults attributed to it in theory, and which the rotary engines have been designed to remedy. We have next taken the practical view of the subject—in simplicity of parts the rotary piston has no advantage over the reciprocating piston; in difficulty of construction the rotary piston far exceeds the reciprocating engine—it is more expensive at the outset—it has more friction—it is more bulky, and less compact—it is inferior in precision and uniformity to the crank engine—and there is a radical fault inherent in the very nature of rotary mechanism, from which it follows that the rotary engine can never be rendered either an economical or a durable machine. We have further shown that, even if rotary engines could be made economical and durable, their very nature renders them unsuited to the great purpose of steam navigation and inland locomotion,—objects to which they have been considered peculiarly applicable. We deemed it an appropriate and instructive conclusion to our enquiry, to examine into the action of the crank, for the purpose of discovering what those remarkable qualities are which have given to the crank of the common steam-engine, its unrivalled superiority as an element for the production of circular motion, and a degree of perfection unattainable by any other mechanism. We have seen that well-constructed crank steam-engines are daily performing duty, which is within ten per cent. of the theoretical maximum of possible effect—of absolute perfection—that this practical perfection arises from the simplicity of the crank, from its wonderful adaptation to the nature and laws of matter and of circular motion in connexion with rectilineal motion—from its reduction of errors either in construction, adjustment, or management, so as to work well without the absolute necessity of greater intelligence, expertness, and precision, than belong to ordinary workmen; and from the compensating nature of the arrangements of its structure, by which it is accommodated, in a remarkable degree, to the necessary imperfections of all human mechanism.

It is my earnest desire, that this exposure may have the effect of inducing some of my ingenious countrymen to direct their exertions for the advancement of the arts and industry of Scotland, to other and more promising subjects of invention. A wide field is open to their exertions in the useful *applications* of the mechanical powers of the common steam-engine to the wants of growing civilization, and to the improvement of the condition of the human race. Let them direct their exertions to these objects, with the industry and unity of purpose which they have already displayed in the pursuit of the fascinating fallacy of a rotary steam-engine, and they will one day be reckoned in the glorious list of those who have been the benefactors of their kind, and the ornaments of Scotland.

Lond. Mech. Magazine.

Bichromate of Perchloride of Chromium.

This remarkable compound was discovered by Berzelieus; it was at first called perchloride of chromium, because when put into contact with water it was changed into chromic and hydrochloric acid. Its true composition was ascertained by M. Heinrich Rose.

M. P. Walter gives the following process for preparing this compound: put into a tubulated glass retort an intimate and finely powdered mixture of 100 parts of fused common salt, and 168 parts of neutral chromate of potash; an S tube is to be put into the tubulure of the retort, through which there are gradually poured 300 parts of concentrated sulphuric acid. The action is rapid from the commencement; intense red vapours, accompanied by much chlorine, are disengaged. The receiver is to be kept cold to condense the vapour. The acid must be gradually added, or otherwise a loss of the red vapours will take place, and besides this the contents of the retort rise and pass into the receiver. As soon as the acid is added, the retort is to be gently heated, and the heat is to be increased, until yellow vapours begin to arise; the operation is then finished. In the receiver there is found a liquid of an intense red colour, and a solid substance, which, according to M. Dumas is a compound of this substance with chlorine. By decantation they may be separated, and the liquor when rectified, so as not to obtain the whole of it, yields a compound, the boiling point of which is constant.

The liquid thus obtained is of a magnificent blood-red colour; it is volatile, and yields fumes abundantly; when put into a quantity of water it falls to the bottom in drops of an oily appearance, and is converted into chromic and hydrochloric acids. Its boiling point is 244° Fahr., and its specific gravity is 1.71; it acts rapidly on mercury; it is decomposed by sulphur, detonates with phosphorus, dissolves chlorine and iodine, and combines with ammonia with the disengagement of light. A small quantity mixed with concentrated alcohol combines with it with violent explosion, and the inflamed alcohol is projected with force. This unexpected action had nearly deprived M. Walter of his eyesight, and burnt him horribly.

The analysis of this substance by M. Walter, agrees with that of M. Rose, namely,

Oxygen, ...	19.28	
Chlorine, ...	45.14	
Chromium, ...	35.58	—100.

Am. de Chemie, et de Physique, 66-391.

It appears to me that it would be more simple to consider this compound as an oxichloride of chromium, than a bichromate of perchloride of chromium. It might then be regarded as composed of

Two equivs. of Oxygen, . .	16 or	20
One equiv. of Chlorine, ...	36	45
One equiv. of Chromium, . .	28	35
	—	—
	80	100

Lond. and Edin. Philos. Mag.

On the action of Fermentation on a mixture of Oxygen and Hydrogen Gases; by M. Theod. De Saussure.

It is well known that the quantity of hydrogen gas contained in the atmosphere does not amount to 1-1000dth of its volume. Nevertheless th

decomposition of organic matters continually adds fresh quantities of this gas to atmospheric air; on the other hand there are few substances which occasion the combination of hydrogen with oxygen at common temperatures; and the circumstances which the combination requires, prove that the disappearance of the hydrogen cannot be accounted for in this way. M. de Saussure states that he has found that the combination is effected by the fermentation of organic substances universally distributed over the surface of the soil, even when on account of the smallness of their quantity and the slowness of their operation no rise of temperature takes place.

By exposing fermentable bodies in pieces of the size of a nut to the mixed gases, M. de Saussure has arrived at the following conclusions:—The combination of hydrogen and oxygen gases may be effected without inflammation at the temperature of the air, by bodies submitted to slow fermentation.

They usually produce this combination when they are accumulated and impregnated with a sufficient quantity of water to prevent their complete contact with the oxygen gas. If this contact be made by increasing the surface of the fermentable body, or by diminishing the quantity of water, the hydrogen gas is not absorbed, and the oxygen gas disappears in other combinations.

The porosity of the fermenting body greatly contributes to the destruction of the detonating mixture.

Many observations prove that the hydrogen gas which disappears by fermentation combines with the oxygen gas, in the proportion of the elements of water. The demonstration requires that the oxygen shall be employed only to form this water, and all the carbonic acid produced in the operation.

The fermentable substances mentioned in the memoir do not effect the combination of the oxygen and hydrogen gases before they ferment, nor when the fermentation is stopped by an antisepfic. Soils and humus, mixed with different earths, undergo a slow fermentation as soon as they are moistened, which gives them the power of destroying the mixture of oxygen and hydrogen gases.

Gaseous oxide of carbon, and carburetted hydrogen gas, obtained by decomposing water with red hot iron, were not destroyed by fermentation when they were substituted for common hydrogen gas, in the explosive mixture formed of two volumes of hydrogen gas and one volume of oxygen gas. Azotic, hydrogen and oxygen gases, added to the explosive mixture, do not present any remarkable obstacle to the destruction of an explosive mixture by a fermenting body, nor to that which is effected under the same circumstances by a plate of platina recently cleaned.

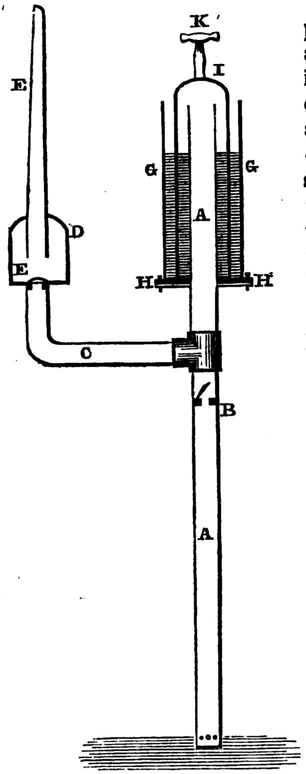
Oxide of carbon, and olefiant gas and others, which prevent the combination of oxygen and hydrogen by platina, are also great obstacles to the same result of fermentation.

Nitrous oxide, added to the explosive mixture, was partly decomposed by fermentation, and did not prevent the combination of the hydrogen and oxygen gases.—*Bibl. Univ. Feb.* 1838. Sup. to Lond. & Edin. Philos. Mg.

Mill's Mercurial Pump.

Sir,—Some time since I constructed a mercurial pump, on what I conceive to be a new plan. I presented a working model to Mr. Grier, lecturer on Natural Philosophy in the Baronial Hall, who exhibited it to his class,

and the action was so satisfactory to the lecturer and his audience, that I have been solicited to transmit you an account of the pump, which I hope you will not consider unworthy of notice in your excellent periodical.



The pump is of the suction kind; A, A, is a pipe not more than 30 feet in length, opened at both ends, the undermost of which is inserted in the well to be drained. At B, there is a clack valve opening upwards, immediately above which a branch pipe, C, leads off, and opens into an air vessel, D, of the ordinary construction. The top of the pipe, C, is furnished with a valve, E, opening upwards into the air vessel, and the ejection pipe is terminated at the required height, F. Immediately above the branch pipe, C, the main pipe, A, A, is begirt with a cylinder, G, G, of iron or glass. The cylinder is of greater diameter than the pipe, but screwed to it at the bottom, H, H, so as to be perfectly air-tight. The cylinder rises to the same height as the pipe, A, A, and the space between them is nearly filled with mercury. A cylinder open at the bottom, and of a diameter intermediate between the cylinder, G, G, and the pipe, A, A, is immersed in the mercury over the pipe, after the manner of a gas holder receiver, but so as to be capable of an easy motion upwards and downwards. The top of this cylinder is furnished with a handle, K. In consequence of the mercury in the cylinder, G, G, and of the valves, B and E, no external air can enter the main pipe, A, A, which enters the well; but the cylinder, I, being lifted by the handle, K, yet not so far as to come out of the mercury, the air within the pipe, A, A, will be rarified, and the pressure of the atmosphere will force the water from the well up the pipe, A, A, so as to pass the valve, B, which opens for its passage. When the cylinder, I, is brought down, the valve, B, shuts, the air is compressed, and the water having no other way of escape, passes through the tube, C, through the valve E, and into the air vessel, D, thence up the pipe and becomes discharged at the orifice, F.

The advantage of this pump is, that little friction is encountered, and for every inch of stroke of the handle, K, the water will be raised one foot.

James Mills.

Glasgow, 13, Clyde Terrace, March 30, 1838.

Lond. Mech. Magazine.

The foregoing is a somewhat novel application of a principle familiar to all who are accustomed to the raising and depressing of air jars in a hydro-pneumatic or mercurial cistern. G.

A New Water Power.

The discovery of a new application of water power, which is likely to be attended with the most important consequences, has lately been made

by a tradesman in Greenock. Like all truly valuable discoveries, it is distinguished alike for simplicity and efficiency. It consists of a cylinder and a piston similar to those employed in the steam-engine. To the cylinder there are two entrance and two discharge pipes, one of each on each side of the stuffing-box of the piston. The same turn of the cock that admits the water into one part of the cylinder opens the discharge pipe in the other, and thus a vacuum is formed. To work this, advantage is taken of the pressure of the Shaw's Water Works, the height of the reservoir of which gives it a force of 60 lb. to the inch, in the lower parts of the town of Greenock. A short time ago, an experiment was tried with a cylinder 2 in. in diameter, worked with a jet of water of somewhat less than a quarter of an inch in diameter, and the piston, although loaded with 1½ cwt., rose and fell 16 times in the minute. In this case the entrance and discharge pipes were equal in size, and the cylinder was placed in a vertical position. Since then, the discoverer has had another model with the cylinder laid horizontally, and with the discharge pipes nearly three times as large as the entrance ones, and by this means the motion was increased to 26 double strokes in the minute. The cheapness of an apparatus of this kind, and its efficiency, wherever there is a sufficient height of water to work it, must be obvious to all, while its manageableness and freedom from danger are no less conspicuous. The merit of this discovery is due to Mr. William Allison, a mason of Greenock, who first suggested this novel application of a well known power to Mr. James Baird, engineer, and Mr. A. Fairgrieve, plumber, who had materially aided him in reducing it to practice. One use to which Mr. Allison conceives it to be peculiarly applicable is, the hoisting of heavy goods into warehouses. The Shaw's Water Company, for *7l.* a year, gives a supply of water equal to 1000 gallons per day. This water injected into a cylinder 10 in. in diameter, he calculates, will raise to the second floor 300 tons per day; to the third floor, 200 tons; to the fourth, 150; and to the fifth, 100 tons. The cost of the water for each day's work is about *5d.* The goods in question will be raised at the rate of 39 ft. per minute. These calculations have proceeded upon the pressure of the water introduced into the town for domestic purposes; but a pipe from the Compensation Dam at the Paper Mill, from its superior height, would give a pressure of about 200 lb. on the inch.—*Greenock Advertiser* as quoted in the *Dumfries Courier*, Sept. 6, 1837.

Arch. Mag.

Whatever ingenuity there may be in the mechanical arrangements of the engine here described, there is nothing new in it with respect to the application of the principle on which it acts. G.

Articles from the French Journals. Translated for the Journal of the Franklin Institute, by J. Griscom.

On the density of Clays, baked at various temperatures; by Aug. Laurent.

It is well known that certain clays have the property of diminishing in volume when heated, and that this diminution increases with the temperature; whence it might be inferred that the density increases in the same

proportion. This conclusion, however, is not accurate, and though the contrary may appear absurd, the absurdity is only apparent, as I am about to demonstrate.

Having cast a prism of kaolin diluted with water to render it more homogeneous, and dried it at about 150°.

Its length was, -	0m.236
Its weight, - -	10gr.852
Its density, (in powder,)	2.643

I exposed the prism, during 6 hours, to a red heat, capable of melting an alloy of three parts silver and seven of gold.

Its length was, -	0m.233
Its weight, - -	9gr.852
Its density, (in powder,)	2.643

Thus far nothing remarkable appears. The volume diminished and the density increased, but not in the same proportion, for there was a change of chemical constitution, since the hydrosilicate of alumine lost about eight and a half per cent of water.

The prism was then heated about six hours at a temperature capable of melting an alloy of equal parts of gold and platina, (temperature of assays of iron.)

Its length became,	0m.212
Its weight,	9gr.814
Its density, (in powder,)	2.481

If its length and weight be reduced to a centesimal scale, we have

	at 150°	at a red heat.	at a white heat.
Length,	100	98.72	90.98
Weight,	100	89.62	89.66

From the red to the white red heat the weight remained sensibly the same while we see that the volume was considerably diminished. It was the same with the density which from 2.643 changed to 2.481.

Having taken another piece of kaolin, I heated it successively, at various temperatures, taking the density each time, and obtained the following results:

	Density.
At 100°	2.47
At 150°	2.53
At 300°	2.60
At a dark red	2.70
At a bright red	2.64
At a temperature somewhat inferior to an iron assay,	2.50
At the iron assay temperature,	2.48

The volume diminishing continually from beginning to end, we perceive that the density increases by degrees to a dull red, at which it is a maximum; that the weight diminishes equally as far as this temperature; and that from this point the density diminishes as well as the volume, while the weight remains constant.

It is very easy to account for the diminution of the density beyond the dull red, considering that the volume, measured in mass, is only an apparent volume, composed of the real volume of the particles and the volume of the air which separated them from each other. By the heat, the parti-

cles approached each other, the intervening air being expelled, and they increased in volume, at the same time. It is similar to what would be observed if we were to take a cubic litre of the filings of beaten gold, melt it and find that it occupied but half a litre, and then ascertaining that the density of this melted gold, reduced to powder, is less than that of beaten gold. As to the cause of the increase of volume of the particles of clay, we may attribute it to the combination which gradually takes place between the molecules of silica and alumina, which are only mixed or partially combined in the unbaked clay. This is conformable to experience which teaches us, that almost always, when two bodies combine, the compound has a density less than the mean density of the two component materials.

Ann. de Chim. et de Phys.

Action of Iron on Benzoic Acid at an elevated temperature; BY FELIX D'ARCET.

In passing the vapour of Benzoic acid over iron at a red heat, we obtain a yellowish oil, fluid, and having an impregnated odour mixed with that of bitter almonds.

This impure oil, distilled in a sand bath, leaves a residuum of tar, and a very fluid colourless liquid distils over, of a peculiar odour.

This liquid boils at 86°, C. At —6° it congeals.

A quantity weighing .235 gr. treated with the oxide of copper, gave .168 gr. of water and .794 gr. of carbonic acid.

Its composition therefore is,

Carbon,	92.065
Hydrogen,	7.935
	100.000

which gives the formula $C.^{24}$ $H.^{12}$

		Calculated.	Found.
C^6	229.5	92.4	92.06
H^2	18.7	7.6	7.94
	248.2	100.0	100.00

This material is therefore Benzine, and its formation is explained in the following manner.

C^{28} H^{12} 0^4 Benzoic acid,
C^{24} H^{12} Benzine produced,

C^4 0^1 Carbonic acid.

When the temperature is raised, carbonic oxide is obtained; but if the temperature is lowered, to a dull red, for example, carbonic acid only is collected.

Benzine may also be obtained, by distilling a mixture of benzoate of potash and arsenious acid. I have had this reaction in seeking a body analogous to the liquor of *Cadet.*

Ibid.

Action of Iron upon Camphor at an elevated temperature. BY M. F. D'ARCET.

In directing the vapour of camphor over iron at a red heat, an oleagi-

nous liquid gathers in the receiver which is very fluid and of a yellow colour.

In distilling this first product in the sand bath, nothing is obtained, and it becomes necessary to raise the temperature to about 145°, then a vapour passes off, and a liquid, slightly yellow, is formed, lighter than water, of a peculiar aromatic odour, having no resemblance to that of camphor, if the operation be slowly conducted.

.187 gr. of this material gave .129 gr. of water and .622 gr. of carbonic acid, by burning it with oxide of copper,—whence its composition is

Carbon,	92.35
Hydrogen,	7.65
	100.00

and its formula; C^{24}. H^{18}.

		Calculated.	Found.
C^{24}.	918.0	92.43	92.35
H^{18}.	74.8	7.57	7.65
	992.8	100.00	100.00

This substance boils at 140°; its composition is exactly the same as that of benzine, but its properties are very different. Can it be a new case of Isomerism? Time does not allow me, at present, to study it with the requisite care: on my return, I shall resume the task and endeavour to clear up this reaction. I have, besides, observed, that when the operation is performed at an elevated temperature, independently of the liquid above obtained, napthaline is also formed.

Ibid.

Preparation of metallic Candle Wick.

Melt 100 parts of tallow, or wax, or any mixture of these, and add 5 to 10 parts of carbonate of lead well pulverised. The materials easily unite by stirring. Steep the wicks in this composition while warm and fluid. When cold the candles may be made upon them by dipping or moulding. In burning these candles the carbonate of lead is decomposed by the heat, and little globules of lead collect on the top of the wick, which bend it out of the flame and thereby increase the beauty and brightness of the light.

Jour. de Conn. Usuelles.

Improvements in Areometers and Thermometers; By M. Dinocourt.

The scales of the French Areometers or Pese-liqueurs are traced on a strip of paper which is introduced into the glass tubes which form the stem of the instruments, and is attached to it by a little sealing wax. These paper scales are liable to become displaced, especially when the instrument is dipped into warm, or hot, water, and thus its value becomes completely vitiated by giving false indications.

This inconvenience has been sometimes avoided by marking the degrees of the scale with a diamond, or by fluoric acid, but this method has been given up in consequence of the difficulty of reading the divisions when thus made, and more especially from the weakening of the glass which they occasion.

M. Dinocourt, agreeably to a report made by Francour to the *Société d'Encouragement* has much improved these instruments by giving the marks

an invariable position on the stem, and at the same time preserving their easy legibility. These he effects by using an enamel powder mixed with gum, tracing the divisions and figures with a pencil, and then by exposing the glass to the flame of an alcoholic lamp so as to bring it to a red heat, the enamel becomes fixed to the glass. Great address is required in this operation so as not to injure the accuracy of the instruments, but Dinocourt executes this delicate work with perfect success.

As strong acids would corrode the enamel, the artist, in the construction of his pése-acides, marks his divisions with gold, which is proof against all but the nitro-muriatic. Various methods have been tried to attach the paper scales immovably to the stem by narrowing the neck, by a spiral wire, by rims of glass soldered to the stem, but none of these expedients have been satisfactory. M. Dinocourt, says the reporter, appears completely to have solved the problem. It is true that his Areometers cost more than the common ones, (his price being from 2 to 3 francs,) but the difference is more than compensated by their superiority.

Thermometers to be used for taking the temperature of acid fluids require similar precautions. M. Dinocourt has applied his improvements to these instruments with the same success. His thermometers cost but five francs.

Bull. d'Encour't.

New method of analysing the Ores of Manganese; By M. Ebelmen.

The process I would recommend appears to me susceptible of great exactness, and it has the advantage of being very easy of execution. It consists in receiving the chlorine, disengaged by muriatic acid from the ore, in a solution of sulphurous acid thoroughly freed from sulphuric acid, and saturating the sulphuric acid produced by muriate of Barytes.

Put a gramme of the ore to be tried, reduced to a coarse powder, in a small vial to which is adapted a bent tube, and pour on it a convenient quantity of muriatic acid. Let the chlorine disengaged pass into a flat bottomed receiver of about 8 oz. about two-thirds full of a solution of sulphurous acid. The chlorine may be disengaged very rapidly as the absorption is always complete as long as sulphurous acid remains in the solution which may be determined by bringing the nose to the edge of the receiver. When the muriatic acid begins to lose its brown tint, the ebullition must be rapidly urged to prevent absorption and to expel completely the disengaged chlorine. Then add muriate of barytes to the sulphurous acid solution, and boil it to drive off all excess of sulphurous acid. Clear the deposite by filtration, and the sulphate of barytes thus obtained gives the proportion of oxygen sought. An atom of sulphate of barytes $\dddot{S}\,Ba = 1458.09$ corresponds to 100 of oxygen. The chlorine in acting on the sulphurous acid solution, reproduces the oxygen which was disengaged from the ore in passing to the state of protoxide: now 100 parts of this oxygen enter into the composition of 1458.09 parts of sulphate of barytes, and I have elsewhere proved that hyposulphuric acid is never formed by this re-action whatever might be the excess of sulphurous acid, for in evaporating the liquor freed from sulphate of barytes to dryness in muriatic acid, and taking it up with water, no traces of sulphate of barytes remained.

The advantages of this process appear to me to be—1st. We are certain that the process at every instant is going on well, that the whole of the chlorine is absorbed and that nothing is lost at the stopper. 2d. That the ore is completely attacked and in a very short time. 3d. This mode presents

an advantage over that of digesting the manganese in sulphurous acid itself, which is a slow process, and which moreover takes from the oxygen of the manganese that which converts the oxide of iron to a protoxide, and therefore does not give the true value of the ore in relation to the chlorine it may produce. Finally, by the last named method, a great quantity of hyposulphate of manganese is formed, the decomposition of which is long and difficult.

Instead of employing sulphurous acid of recent preparation, we may use solutions of long standing and which contain, of course, sulphuric acid. It is sufficient to add to these a certain quantity of muriate of barytes; as oxygen is absorbed, sulphate of barytes is precipitated. When used, decant the clear fluid. The chlorine is then passed into a mixed solution of sulphurous acid and chloride of barium; each bubble of chlorine gives rise to a portion of sulphate of barytes.

Annales des Mines.

Crayons for Drawing on Glass.

Take equal quantities of asphaltum and yellow wax and melt them together. Add lampblack sufficient to give the mixture the requisite colour, stir it well, and pour it in moulds for crayons.

The glass should be well wiped with leather, and in drawing care must be taken not to soil the glass with the fingers.

It is sometimes difficult to trim the crayons with a common knife, for if too sharp it cuts in too much, and if too dull it cannot make a fine point. But if the edge be bevelled like scissors, and very sharp, the point may easily be rendered very fine.

Rec. de la Soc. Polytec.

Observations of Berzelius, on the methods of Paton *and* Marsh *for detecting Arsenic.*

To discover arsenious acid in animal matter, Paton recommends, 1st, to precipitate all these materials from the solution by an infusion of nut galls, and then to decompose the arsenious acid by sulphuretted hydrogen. It is not certain that this method is preferable to that of Tauflieb in which the animal matter is precipitated by a solution of oxide of zinc in caustic potash.

Marsh proposes another method which is worthy of all attention, as it succeeds with extremely small quantities of arsenic.* It is based on the transformation of arsenic into arseniuretted hydrogen, which, according to his statements, takes place very promptly when the suspected mass is acidulated with sulphuric acid, and a piece of zinc added. The hydrogen gas disengaged takes up the arsenic, and Marsh has contrived a very ingenius little apparatus for the experiment, but he manages the gas badly for the purpose in view. He passes it through a fine opening, inflames it, and then receives the flame either on a glass plate, or in a glass tube open at both ends, on which the arsenic is deposited in a metallic state or mixed with arsenious acid.

Marsh has neglected one property of this gas of which we may avail ourselves with much greater certainty, viz. that of depositing its arsenic by heat. Nothing more is necessary than to direct it into a tube heated to redness in one spot; the arsenical hydrogen is decomposed, the arsenic depos-

* See Jour. Frank. Inst. Vol. XVIII, page 338.

ited in the adjacent colder portion of the tube, and the hydrogen gas escapes in a state of purity. For this purpose nothing more is necessary than a common gas bottle, leading the gas, as it issues, through a glass tube, made hot by a spirit lamp. We may, if inclined to greater certainty, put into the red hot part of the tube, a small weighed quantity of copper reduced by hydrogen, white arseniuret of copper is formed, and by re-weighing it, we may estimate with the greatest exactness the weight of arsenic which accompanied the hydrogen.

I dissolved a millegramme of white arsenic in a little dilute sulphuric acid, and added above 6 ounces of water and some zinc. The hydrogen was passed over a little weighed copper, previously reduced by hydrogen and heated to redness in a narrow glass tube. The presence of the arsenic was very evident; the anterior portion of the copper became silvery white, and heated by the blow pipe it diffused a strong odour of arsenic. Having made the experiment with a centigramme of arsenious acid, I obtained about two-thirds of the arsenic which it contained, combined with the copper. This process, admitting it not to answer for a quantitative, deserves our entire confidence in a qualitative analysis and in its application to every case of medical jurisprudence. Jour. de Pharmacie.

To dye Wool and Goat's Hair a delicate blue.

M. Buisson, apothecary, has communicated to the Royal Society of Agriculture at Lyons a new and very simple process. The colour is strong enough to resist water, the sun, and even soap, while that obtained by dye woods fades much more easily, and is very inferior in brightness in an artificial light.

To obtain this colour as pure, fresh and deep as possible, the water of the bath while cold must be first saturated with chrystallized verdigrease (acetate of copper.) then slightly acidulated with acetic or pyroligneous acid; dip the stuffs in the usual way, then wash and dry them.

Jour. de Conn. Usuelles.

Composition of a Varnish for common Candles intended as a substitute for wax candles.

Take equal parts of the balm of benzoin and resin mastic: put each of them in a separate vessel of glass or lead, add spirits of wine, and heat them gently till the resinous parts are dissolved. Let each of the solutions remain a while at rest and then unite them in one vessel.

Prior to using this composition it is advisable that the fluid be heated to 25° or 30° Cent. (= 80 or 90 Fah.) Dip the candle in it from 5 to 10 seconds, then dry it carefully, which will take about 10 minutes. The proportion of the ingredients may vary, but in proportion as the benzoin is diminished and the mastic increased, the candles becomes more liable to soften by handling. If the benzoin be increased, the candle dries too soon and loses its polish and colour. The quantity of alcohol will vary according to the thickness of the coat to be given to the candle. Ibid.

Protest.

M. Pistrucci, who holds a station in the mint at London, is announced as the inventor of a process for striking a matrix with a punch which has never

been touched by the graver, and which gives, nevertheless, a medal identically the same as the original model in wax. In this operation, the beauty and perfection of the design are at a single blow transferred to the metal whether of gold, silver or copper.

"The process is this: The model being given in wax, earth, wood, or any other convenient material, take a mould of it in plaster, when the mould is dry or oiled: to harden it, take an impression of it in the moulding sand for cast iron, as fine as possible in order that the points may be sharp, and that the materials may become as hard as tempered steel. The back is to be dressed to a plain surface. This piece solidly fixed in a piece of steel, becomes the matrix on which may be struck, either the medal itself, or a punch if it be desired to multiply steel matrices of the medal. M. Pistrucci has tried his process on medals three inches in diameter and with perfect success. The importance of such a discovery is very obvious. Not only medals, but many pieces of jewelery which require to be chased, may be treated in the same manner."

Permit me to say, Mr. Editor, that this important discovery, as you may be easily convinced, is two years and a half old. At that epoch I made known at the Royal Mint in Paris, all that M. Pistrucci has just done in London. A plan of the apparatus and the details of the operation were deposited by me in the Royal Mint, to be placed at the disposal of my fellow labourers in France. They are in the cabinet of the director of the mint.

Since that time the medal engravers have employed my process, and more than thirty medals of the reign of Napoleon have been thus re-produced. You may easily, Mr. Editor, obtain a proof of my statement on application at the Mint.

Caqué, Engraver in the Gallery of the Kings of France;
Royal Mint, Paris.

Jour. de Conn. Us. et Prat.

Method of cleaning Glass.

Reduce to very fine powder a piece of indigo, moisten a rag, apply it to the powder and smear the glass with it. Wipe it well with a dry cloth.

Very finely sifted ashes applied in the same manner by a rag dipt in brandy or spirits of wine will answer well; but spanish white ought to be rejected as it is apt to take off the polish of the glass. Ibid.

Progress of Physical Science.

TRANSLATED FOR THE JOURNAL OF THE FRANKLIN INSTITUTE, BY J. GRISCOM.

On the part which the Soil acts in the process of Vegetation. Memoir read at the Academy of Sciences, by J. Pelletier.

The ground is the support and nurse of plants; in its bosom, by means of roots, they seek for and find a portion of their nourishment. But to this truth, so simple and obvious, are attached questions of a complicated nature, and of the highest interest to Physiology and Agriculture. With one, among others, I have been particularly arrested, and it has been the object of my meditations. Before I enter upon it, permit me to bring into view some facts which appear to be necessary to the discussion of it.

The earth is not an elementary substance. Its exterior bed, the residence of plants, is formed of various metallic oxides, silica, alumina, lime, to which are often joined magnesia and the oxide of iron. It contains, moreover, the detritus of organic matters which had before possessed life and existence. Thus constituted, and under the influence of air, water and imponderable fluids, the earth is eminently fit for the development of germs deposited in its bosom, and to the growth of the vegetables which flourish upon it.

The necessity of the presence of organic matter, to constitute a soil, endowed in the highest degree with vegetative force, cannot be considered doubtful. In vain did Tull, in 1773, attempt to maintain that distinct earthy particles formed the sole nourishment of the plant. This theory was overturned by the positive experiments of Duhamel, who had at first embraced it. Nevertheless, if it is certain that the presence of organic matter is a condition of fertility, we may still ask whether it is so *essential* a condition—such a *sine qua non*—that a plant cannot vegetate in a soil totally deprived of organic matter, particularly if other circumstances, such as the presence of water and carbonic acid, be united with it.

Numerous experiments have been made to resolve this question. Many of them are contradictory. The greater portion, from the high interest which they involve, ought to be discussed and repeated with care. But another question not less important, and which I think ought to be first ascertained, is this: *What influence have soils themselves in the act of vegetation?* To this question I at present confine myself.

A vegetable soil, in its normal state, must be considered a mixture of various earths, that is, of metallic oxides.

Every soil devoted to Agriculture, is, in general, says Chaptal, formed of a mixture of silica, lime and alumina, and in support of this assertion he cites various analyses.*

Davy confirms this statement in his Agricultural Chemistry, and in fact,

* A very fertile soil in Sweden was found by Bergman to consist of:

Coarse Silex,	30	56
Silica,	26	
Alumina,		14
Carbonate of Lime,		30
		100

A fertile soil in Middlesex gave Davy—Siliceous Sand 3·5; the remaining 2·5 consisted of

Carbonate of Lime,	28
Silica,	32
Alumina,	39

Analysis of a fertile soil in Touraine:

Sand,	49
Silica,	16
Alumina,	10
Carbonate of Lime,	25
	100

A very fertile compost, formed by Tillet consisted of clay 3-8, pulverised lime-stone 3·8, sand 2-8, corresponding to

Coarse Silex,	25
Silica,	21
Alumina,	16.50
Carbonate of Lime,	37.50
	100

not a single instance of a fertile soil has occurred, which consisted of only one earth, or even of two, such as lime and silex, silex and alumina, allumina and lime.

In another passage in his *Chimie Agricole*, Chaptal expresses himself thus: "A mixture of lime, silex and alumina forms the basis of a good soil; but that it may possess all the desirable qualities of good land these ingredients must exist in certain proportions, which analyses of the best soil can only establish.

If we consult the analyses of the most fertile soils, we find that fertility diminishes in proportion to the predominance of either of these principal earths, and that it becomes almost null when the mixture has the properties of only one of them."

Complexity of composition is therefore, in general, a condition of fertility in a vegetable soil. The loose earth which we find in vallies arising from the decomposition of primitive rocks, makes generally an excellent soil. Now, we know that granite, composed of quartz, feldspar and mica, and frequently amphibole, must yield by its decomposition, a soil containing silica, lime, alumina, and a little magnesia and sometimes potash. Soils, originating on the contrary, from the decomposition of more simple rocks, siliceous limestone, for example, are lighter, and suitable only for a limited number of plants; they require, says Chaptal, to be enriched, and are valuable only in moist climates. Land originating in the decomposition of trap, basalt and other rocks of complicated elements, possesses, on the contrary, great natural fertility.

"Rivers," he further adds, "receive in their courses other streams whose mud is mingled with its own, and it often happens that the united sediment of two rivers possesses greater fertility than that of either separately."

This then appears to be an established fact, that a soil, (independently of organic matter) is the more fertile as its composition is more heterogeneous.

If we seek for an explanation of this fact, we find in authors only vague opinions and doubts; the greater number merely state the facts without attempting an explanation.

Agricultural chemists, who indulge more in theory, appear to regard the cause of fertility as dependent on the physical character of the soil rather than on its chemical constitution. Thus Davy having observed that different soils attract moisture with different degrees of energy, and having discovered, as he believed, that the most hygrometric soils were the most fertile, he ascribes their superior fertility chiefly to this property. But Davy has not proved that the hygrometric force of a soil bears any given relation to its composition.

If this attraction for moisture were the principal cause of fertility (abating the influence of manures) we perceive no necessity for the combination of the three earths in the constitution of a soil of the first quality. Indeed a certain quantity of alumina in a soil otherwise entirely siliceous, or entirely calcareous, a certain proportion between the adhesive and the loose or sandy portions, would be sufficient to confer this hygroscopic quality, and of course the fertility of the soil. But we have nothing to confirm this supposition.

The hygroscopic quality of a ternary soil may then be considered as an *element* of fertility, but only a secondary element, subordinate to its chemical composition.

The property of becoming more or less heated by the rays of the sun, which appeared to Davy to hold a relation to the fertility of different soils, appears to me to be also a secondary cause. In the cases referred to by him there was a mixture of black mould, and he did not sufficiently consider its fertilizing action as a manure upon the soil.

To me, it appears evident that the mixture of the various earths which compose a soil, acts upon vegetation and determines its fertility *by an electro-chemical force*, whose action has been clearly recognised in other circumstances, but not yet brought into view in the case now under consideration. In the first place, let us observe that it is a fact, though the truth may have escaped observers, or rather, it has not yet been brought under a formula, that the silica, alumina and lime which enter into a good vegetable soil, must not be combined with each other, but simply mixed, the lime being in the state of a carbonate. A triple silicate of lime or alumina, in which the silex, lime and alumina should be in the proportions which constitute the best arable land, could not, even if thoroughly divided, furnish a soil essentially adapted to vegetation. If in a fertile soil, composed of a mixture of lime, alumina and silica, a combination between these three oxides should begin to take place, the ground would become cold and sterile. Now, it is certain that in a mixture of these three ingredients, a force does exist which tends to combine them. The silica and alumina are, in relation to the lime, electro-negative bodies, and in their presence the lime must acquire a contrary electricity. According as external or mechanical movements of the soil, or other foreign causes, shall bring these molecules within greater or less distances from each other, and group them in various ways, electrical piles will be established, discharges will take place, producing various tensions, and the earth will thus, if we may use the term, become animated. The electric fluid which pervades it will excite the stomata of the radical fibrils, determine the play of the organs, and the absorption of the fluids requisite to the nourishment of the plant. The radical fibrils, and the capillary roots impregnated with moisture, will become so many electrical conductors, engaged in transmitting electricity, certainly as necessary to life as light and caloric.

The merit of a theory is that it accounts for observed facts, enables us to foresee what will take place under particular circumstances likely to happen, and indicates the considerations which it may be desirable to bring about with a view to useful results.

Let us enquire whether the theory now presented fulfils these conditions:

Suppose a chalky soil. To improve it we add argillaceous marl; i. e. to the lime which predominates we add silica and alumina. *To the positive element which we found alone, we add the negative elements which we found deficient.*

Will it here be said that "chalk is so compact that the roots cannot penetrate it, or so split up that water passes through it like a riddle, and that the marling is simply designed to change this physical condition.*

But, if the object was merely to divide the chalk, in order to change its physical condition, a calcareous sand would accomplish this object, and yet it never came into the head of an agriculturist to improve his chalk by limestone, while Gordan de Saint-Memin produced a magnificent vegetation by a mixture of chalk with heath sand.

In a piece of ground belonging to Chaptal, the soil was clayey and rather barren; below was a layer of black earth. Chaptal went to work emphirically, dug up the ground and mixed the two beds together. Contrary to his expectations, the sterility was increased. It was not till the fifth year that the ground acquired a common degree of fertility, that is, when all the iron had passed to the state of peroxide, and the land, black as it was, had

* G. Dict. d'Agriculture, article *Craie.*

become of a deep, bright yellow. Chaptal asks, if in this case the black oxide is injurious to vegetation, either by itself, or in reference to the oxygen.

In our theory the fact explains itself, and might have been foreseen:—the black oxides of iron (fer oxidule' d' Haüy) is a combination of protoxide and sesquioxide of iron, a substance *indifferent* in relation to silica and alumina. Exposed to the air the combination is destroyed, the iron passes to the state of peroxide, susceptible of union with silica and alumina. Yet, under such circumstances it was not worth while to mingle the two beds, since five years were lost in attaining a common degree of fertility.

The theory which we have adopted is applicable likewise, in the happiest manner, to the operation called marling. Marl is not a simple mixture of silica and alumina with more or less of carbonate of lime. Its base is argillaceous and calcareous silicates; some mineralogists consider it even as an oryctognosaical species.* It is on this account that plants cannot vegetate in marl which has not been long exposed to the air, even when the silica, alumina and lime are in the proportions which form good arable land. By exposure to the air, carbonic acid *destroys the combination* which existed between the earths, and it is then, and then only that marl will enrich the soil. In this case, if the negative element prevails, as in the case of argillaceous marls, it becomes excellent for calcareous soils; and marls called calcareous are in their turn advantageous for argillo-sandy land.

It has been remarked that the alkaline and earthy salts, which, in a certain quantity, injure vegetation, produce a good effect when employed in small doses. Chemists and farmers have sought to explain this action of saline compounds. Some have thought that certain salts were good for plants, as some are for animals,—that salts, and even earths, formed part of the food of vegetables; others, on the contrary, that they act principally as stimulants to vegetation. Without denying that earthy substances may enter into the constitution of a vegetable, to unite and give strength to the parts that are to support the organs, like phosphate of lime in the bones of quadrupeds, I may remark, that with a few exceptions, the presence of any salt is not absolutely necessary to vegetation. Thus, for example, borage and lettuce, whose extracts contain much nitre when they grow in highly manured soils, do not contain any sensible portion of it when cultivated without dung. I therefore, rather incline to the opinion of Physiologists, who think with M. Decandolle, that salts act as excitants or stimulants. But, what is the meaning of excitation? At the present day, science no longer admits of those vague explanations which consist of nothing but words. I understand by excitation, the eminent property of conducting electricity which salts communicate to water. It is in this manner, as it appears to me, that nitrate of potash acts, in the prodigious energy which it gives to vegetation. It is probably in this way that sulphate of lime acts—that is to say, by rendering the water a better conductor, though in this case the effects appear to me to be complicated, and to be worthy of direct experiment.

Thus far, for greater simplicity, we have considered lime as free, in speaking of the mixture of silica, alumina, and lime, which constitute a soil: now the lime is in the state of carbonate, but it does not in that state cease to be an electro-positive element in relation to silica and alumina. This circumstance allows us to explain an important vegeto-physiological fact.

* Brochant's Mineralogy.

The carbon in vegetables is produced mostly, if not entirely, by the decomposition of the carbonic acid which they absorb not only from the air, but from the ground: such is the opinion of the celebrated Decandolle. This carbonic acid, furnished by the ground, appears to enter into the vegetable at the moment of its liberation, probably dissolved in the water which the soil contains. It is absorbed by the spongioles of the radicules; it ascends with the sap, urged forward as by a *vis á tergo*. But how is this carbonic acid produced? In certain manured soils, and in superficial portions of the earth, penetrated by the air, we may conceive it to be formed by the re-action of oxygen upon the carbon of organic detritus; but at those great depths which are attained by the roots of oaks and cedars of a hundred years old, how can the carbonic acid be developed? How can the oxygen and organic matter penetrate to such depths? In our theory there is no difficulty. Carbonic acid comes from the lime, on which the silica and alumina act slowly but continuously to form silicates.*

Thus then, at certain depths, and under influences but little understood, silica would decompose carbonate of lime, while at the surface of the earth, and under the influence of exterior agents, the silicates would be decomposed by carbonic acid produced by the re-action of the oxygen of the air on organic detritus,—an admirable and providential rotation, which re-establishes the equilibrium, and incessantly tends to the rejuvenescence of nature.

The last corollary of my theory,—the decomposition of silicates by exterior agents, and particularly by carbonic acid, cannot be called in question. It has been established by M. Becquerel, under circumstances in which the force of cohesion might seem to present a serious obstacle. I allude to the decomposition of the feldspar of granite, and the formation of kaolin. The analogy is here so strong that I must render the homage of my first conception to the distinguished academician I have just cited.

The fact of the decomposition of carbonate of lime by silica in the interior of the earth is equally supported by experiment and observation. And first, if, in proceeding to the analysis of a vegetable soil, when the coarser siliceous sand has been separated by agitation and deposition, and the carbonate of lime has been removed by weak acids, we examine the finer terrene substance which has resisted the weak acids, we find that it is not alumina, as Chaptal indicates, nor silica, as is stated in various works, but that it consists principally of veritable silicates of lime, of alumina, and of oxide of iron.

Still, it may be objected that these silicates are anterior to all vegetation; that to prove their recent formation and daily production, requires direct experiments. These direct experiments are among the objects which I wish to undertake. They require much time. But to prove truth, are we to depend solely upon new experiments peculiar to him who advocates it, and are we forbidden to rely on the labours of our predecessors? Certainly not. I may therefore again refer to the interesting researches of M. Becquerel, and bring into view those mineral species which he has formed in his laboratory, and which present all the characters of their natural congeners.

* Animal manures may contribute to the decomposition of silicates, not only by the carbonic acid which they form by absorbing oxygen from the air, but in producing such substances as the *fat acids*, which have a tendency to unite with lime and to eliminate the silica which is combined with it. M. Raspail, whose talents we are glad to acknowledge, without sharing in all his scientific opinions, appears to us to have explained the siliceous petrefactions that are found in chalk, in a very happy manner by the action of animals entombed in siliceo-calcareous beds. (Physiol. Vegetate t. 2. p. 339.)

Neither can I omit to mention the important fact of the artificial formation of feldspar by Cagnard de Latour.

There is still another objection which may be made to the theory now presented. If in this mixed state, the earth acts by virtue of electro-chemical forces, why are three earths requisite to the construction of a good soil? Ought not silica and lime, or lime and alumina to be sufficient to produce, in each element of the mixture, an opposite electricity? It is easy to answer this objection also, by a reliance upon facts well known to mineralogists: it is certain that the binary silicates are more rare in nature than the ternary silicates, and that their mass in particular is less powerful: silica has therefore a greater tendency to combine with lime and alumina together than with either of these earths separately. Hence we may perceive that the union of the three becomes necessary to constitute a soil endowed with the highest degree of vegetative power.

If the ideas which I now submit to the Academy appear to deserve any attention, I propose, on the return of the favorable season to renew the enquiry, and to devote myself to the labour of positive experiment,—experiments, which, whatever may be their results in reference to my theory, will at least have the advantage of eliciting facts which may be friendly to agriculture, that science which is so prominently stamped with the character of utility. Jour. de Pharmacie.

Indications of Organic remains in the oldest Rocks of the Globe; means of distinguishing Trap from Basalt; By Henry Braconnot.

The author examined some specimens of Trap from the neighbourhood of Essey, in the south of the department of La Meurthe, a region which had been considered by some naturalists as volcanic, although neither crater, lava nor scoria was to be found in it. Some prisms of blackish basalt are indeed obtained there, but it is well known, he remarks, that certain traps are found under geological conditions which forbid all idea of volcanic action. This pseudo-primitive form is due to the shrinking which the rock undergoes in drying. To determine whether these prisms from Essey had undergone the action of fire, he resolved to compare them with true volcanic basalt. He subjected to distillation, in a small glass retort, some of the Essey basalt, pulverized, and obtained from it an empyreumatic, ammoniacal product, which restored the blue colour of paper reddened by tournesol. The residuum of the distillation had a deeper shade than before, so that the carbon seemed to have been more exposed. Various other genuine traps from different places were in like manner powdered and distilled, and furnished absolutely the same product as the first.

From these facts he infers, that all these enormous masses of Trap which are found in the chain of the Vosges and in other places, have been formed in water under the influence of moderate temperature, and that prior to their formation the remains of organized beings were intimately mingled with the other elements of which they are constituted.

He next examined true basalt, which had incontestibly undergone the action of subterranean fire. A portion from Clermont in Auvergne was heated to redness in a glass tube closed at one end, and in which a strip of paper reddened by litmus was placed. Instead of changing to blue, as had been the case with the traps, no change took place; which shews that the organic substance which may be presumed to have existed among the materials of basalt before its formation, was destroyed by the volcanic fire.

By this test the author thinks volcanic basalts may be easily distinguished from traps, and that it may put an end to the discussions which still divide geologists, and banish the confusion which prevails in the determination of the rocks called *Basaltes.*

This unexpected discovery of animal matter in trap rocks, regarded by some geologists as contemporaneous with granite, induced him to examine that also. Some ancient granite, enclosing porphyroidal eurite was heated nearly to redness in a glass tube with reddened litmus paper, which very soon changed to blue. A slight odour appeared which was somewhat empyreumatic, though much less decided than in the case of the traps. Another specimen of ancient granite gave a similar result, and Egyptian sienite from the collection of M. Haldat yielded an ammoniacal odour on distillation.

"I conclude from these facts, that rocks regarded as forming the centre of the terrestrial globe, or at least as the nucleus of primitive mountains, include vestiges of organic remains, and that, however their formation may be explained, it has not taken place at a high temperature. I have also examined in the same way, several ancient rocks nearly contemporary, such as green porphyry and serpentine, which, like granite, gave a product scarcely empyreumatic and restored the blue of tournesol. Some granitoid amphibole from Tillot, (Vosges,) yielded an aqueous ammoniacal product of an odour decidedly empyreumatic, which seemed to indicate a formation less ancient than granite. Gneiss from Mybury, in Saxony, gave an acid which acted on the retort, apparently fluoric acid.

Some spotted sand-stone from Vosges, collected at the surface of the ground, furnished no signs of organic matter. Further extension might be given to these enquiries, but the facts here stated appear to me sufficient to change, or modify, our different hypothesis of the origin of rocks and the state of the globe at the epoch of their formation. Ann. de Chem. et de Phys.

Changes of Temperature which our Globe has undergone; by M. L. Agassiz.

In a very interesting discourse on the Glaciers Moraines, and erratic Blocks of the Swiss Mountains, delivered at the opening of the Helvetic Natural History Society, at Neuchatel, on the 24th of July, 1837, by its President, M. L. Agassiz, an account is given of the phenomena of the changes produced by the agency of Glaciers in remote periods, especially on the southern slopes of the Jura; to account for which the celebrated author adopts a theory of temperature quite new, it is believed, in Geology, notwithstanding the fertility which has characterised the opinions of those who have written upon this subject within a century or two past.

It is well known to those who have visited the Alpine regions that the Glaciers, or immense bodies of ice, which fill up more or less of the intervening space between the ridges that exist on the sides of the mountains, push along in their descent masses of stones and rubbish which collect on their sides like winrows, and which are known by the name of *Moraines.*

But it is not so well known that ancient *Moraines* are to be seen at various successive heights, both upon the Jura and the Alps, forming walls which follow the sinuosities of the sides of the valleys. Many stages of them are seen, some of which are some hundreds of feet above the bottom of the upper valleys of the Alps, where Glaciers now no longer exist.

Some there are which are quite distinct at a height of two thousand feet above the valley of the Rhone, above its entrance into the lake of Geneva.

A striking phenomenon also is the polished appearance of the surface of the rocks over which these ancient Glaciers have passed, evidently produced by the abrasion of the stones and gravel which have been urged along by them. Traces of these former Moraines may be followed even to the margin of the lake of Geneva. Whole sides of the valley of the Rhone are thus polished to the very shores of the lake, evidently produced by great masses of ice, which in former times have filled the bottom of all the Alpine valleys. Their polished surfaces, (denominated *laves* by the mountaineers,) are formed on the southern slope of the Jura, which fronts the Alps, to its very summit.

Moraines are witnessed on the very margin of the lake of Geneva, and on both banks, at the same elevation, rendering it certain, according to Agassiz, that there was a time when the lake was frozen to the bottom, and when the ice was elevated to a considerable height above its present level.

On the southern slope of the Jura are also large blocks or boulders of Granite which must have come from the Alps, some of which are of the size of 50,000 cubic feet. These are usually less rounded and are even of a larger size than those which are found in the Moraines at the margin of the existing Glaciers. These large angular blocks repose on small blocks, or pebbles, rounded by attrition and these again rest upon smaller, which pass below even into a fine sand, lying immediately over the polished surfaces of the Jura rocks.

The removal, or transportation, of such boulders has been very generally attributed to vast currents of water, or to floating ice. But the insufficiency of this theory appears very evident from the order of superposition, which is constantly opposed to all idea of a transport by currents. To account satisfactorily for the existence at once of these ancient *Moraines*, of the unpolished surface of the sides of the valleys, and of the order of superposition, is the great object in question. I must give the theory of President Agassiz in his own words, as I find it in a translation of his discourse in *Jameson's Edinburgh New Philosophical Journal.* G.

I shall now proceed to that explanation of the phenomena which I consider the most plausible; and which is the result of my own views, together with those of M. Schimper, upon the subject. In glancing at many general questions which are connected with the explanation, I have no intention of expatiating upon them. I wish simply to demonstrate that the subject now before us has a relation to the most interesting and important geological inquiries.

The study of fossils has for some time led to very unexpected results, especially since it has assumed a physiological character; that is to say, since it has been recognised, that a progressive development exists in the whole range of those organized beings which have formerly peopled the earth; and since epochs of renewal have been recognised throughout the whole. Those individuals who have admitted this progression ought not now to entertain any fears in prosecuting these consequences to their legitimate limits; and the idea of a uniform and constant diminution of the earth's temperature, such as is now sometimes admitted, is so contrary to every physiological idea, that it must be strenuously repelled, to make way for another, viz. that there has been a diminution of tem-

perature, which has been accidental in relation to the development of the organized beings that have appeared and disappeared one after the other at determinate epochs, maintaining itself at a particular mean temperature during a giving era, and diminishing at certain fixed epochs.

As the development of individual life is always accompanied with that of heat, since its continuance establishes a certain equilibrium of longer or shorter duration, and since its extinction produces an icy coldness, I conceive I deduce only legitimate inferences, when I conclude that the same phenomena occurred upon the globe: that the earth, when it was formed, acquired a certain very elevated temperature, which progressively diminished during the different geological formations; that during the continuance of each of them, the temperature has not been more variable than that of our globe since it has been occupied by its present inhabitants, but that it has been at the epochs of the disappearance of these inhabitants that a fall in the temperature has taken place, and that this fall has been beneath the temperature which prevailed in the subsequent epoch, and which re-appeared with the development of the newly animated creatures which were called into existence.

If this theory be correct, and the facility with which it explains so many phenomena which have hitherto been deemed inexplicable, induces me to believe that it is, then it must follow that there has been, at the epoch which preceded the elevation of the Alps and the appearance of the existing animated world, a fall of temperature far below that which prevails in our days. It is to this fall of temperature that we must attribute the formation of those immense masses of ice, which must universally have covered the surface, where we find these erratic blocks along with rocks which are polished as are ours. It is also, unquestionably, this extreme cold which has enveloped the Siberian mammoths in ice, has congealed all our lakes, and accumulated the ice as high as the ridges of our Jura, which existed before the elevation of the Alps.

This accumulation of ice above all the hydrographic basins of Switzerland may easily be supposed, on reflecting that when lakes are once frozen to the level of their emerging current, the running waters no longer drain off, and those of the atmosphere, augmented by the vapours of the southern regions, which under the circumstances, abundantly precipitate themselves towards the north, must have most rapidly augmented the extent, and raised the level even to the height which has already been established by the foregoing facts. The winter of Siberia was for a time established upon a soil previously covered with luxuriant vegetation, and peopled with great Mammalia, whose fellows in our day inhabit the warm regions of India and Africa. Death enveloped nature in its winding-sheet, and the cold reaching its extremest limit, gave to this mass of ice, at the maximum of tension, the greatest hardness it could acquire. When any one has frequently witnessed the congelation of a lake, he can then form a conception of the vast resistance of ice in this condition, and to what immense distances hard bodies which are thrown upon its surface may glide in consequence of even a feeble impulse.

The appearance of the Alps, the result of the greatest convulsion which has modified the surface of our globe, found its surface covered with ice, at least from the North Pole to the shores of the Mediterranean and Caspian Seas. This upheaving, by raising, breaking, and cleaving in a thousand ways, the rocks which compose the prodigious mass that now forms the Alps, at the same time necessarily raised the ice which

covered them; and the debris detached from so many deep upbreakings and ruptures, naturally spreading themselves over the inclined surface of the mass of ice which had been supported by them, slid along the declivity to the spots where they were arrested, without being worn or rounded, since they experienced no friction against each other, and even when arrested came in contact with a surface so smooth; or after being stopped, they were conveyed to the margin, or to the clefts of this immense sheet of ice, by that action and those movements which characterise congealed water when it is subjected to changes of temperature, in the same manner as the blocks of rock which fall upon the glaciers, approach their edges in consequence of the continual movements which the ice experiences, in alternately melting and congealing at the different hours of the day and seasons of the year. These effects ought to be described in detail; but as they are partly known I shall not dwell upon them.* I shall only remark, that the power of the action, so far as the ice is concerned, is immense; for these masses, continually moving upon each other, and on the surface, bruise and grind down every thing movable, and polish the solid surfaces on which they repose; at the same time that they push before them all that they encounter, with a force which is irresistible. It is to these movements we must attribute the strange superposition of rolled pebbles, and of sand which immediately repose upon the polished surfaces; and it is unquestionably to the grating of this sand upon these surfaces that the fine lines which we find are owing, and which would never have existed if the sands had been acted upon by a current of water; for neither our torrents, nor the stormy waters of our lakes, produce any thing like this upon the very same rocks. As to the longitudinal direction of these fine lines, and of the furrows which are observed upon the polished surfaces, it ought to be observed that they must have resulted from the much greater facility which the ice had in dilating itself in the direction of the great Swiss valley, than transversely, confined as it was between the Jura and the Alps; the phenomenon itself commencing only with the retreat of the ice, at the time that the Alps appeared. I have not the slightest doubt that the greater number of the phenomena which have been attributed to vast diluvial currents, and in particular those which M. Seefstrom has recently made known, have been produced by ice.

Upon the elevation of the Alps, the surface of the earth would be reheated, and the caloric disengaged on every side would produce the melting of the ice, which would gradually retire into its present domain. Clefts would first be formed in those places where the ice was thinnest, that is to say, on the summits of the mountains and the hills which were covered by it, afterwards upon the most saliant parts of the plain; valleys of drainage would then be excavated at the bottom of these clefts, in localities where no current of water could flow without being inclosed within congealed walls; and when the ice had completely disappeared, the great angular blocks which had covered its surface, or had fallen into the clefts, would be found upon a bed of small rounded pebbels, under which is usually found a layer of sand. In melting from the surface, the ice must necessarily have continued longest in the depressions of the country, in the little longitudinal valleys which are formed by the dif-

* M. Schimper has written a most interesting work upon the effects of ice, to which I should have been most happy to refer if it had been published.

ferent zones of the strata of the Jura, and at the bottom of the lakes; and it is undoubtedly to this circumstance we are to attribute the extraordinary position occupied by so many of these blocks, which are perched up, scarcely in equilibrium, upon the highest points of rocks; and also their constant absence in the hollows, where they are not found, except, at least, where fresh momentary expansions of the ice were able to precipitate them.

So long as the level of the ice on the Jura had not fallen below the line of Pierre-à-Bot, the blocks which were yet spread over its whole surface, might continue their descent towards the Jura; but so soon as the ice became thin over the plain of Switzerland, it must have very speedily disappeared, and have only left portions in the deep valleys, and in the basins of the lakes, that is to say, it must have been soon confined to the lower valleys of the Alps.

In reflecting upon what must necessarily have occurred upon this disappearance of the ice, we are naturally led to think that the transport of the rolled pebbles of the valley of the Rhine, and the deposition of *Löss*, must have been among its first effects; and this is confirmed by the facts, that these pebbles are the same with those which we found along with our blocks, and that the *Löss* is evidently the result of the detritus of the *molasse*. The frequent *dèbâcles* of the ice could only at that time convey blocks upon the masses of ice to great distances, or carry them farther in their current.

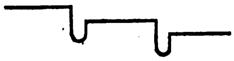
The melting and maceration of the ice and its repeated congelation in cold weather have produced many other geological effects, which it is difficult to account for as produced by any other causes. Without again recurring to the valleys of drainage or erosion, I may mention those deep furrows which are not fissures, and which have above them plains of great extent; also those small lakes which are sometimes formed near the edges of the glaciers, and which so affect the small stones that are accumulated at their margins, as to impress upon them the appearance of stratification; or again, the analogous phenomena which are observed upon the limits of different stations where the immense sheets of ice have successively stopped in their retreat; and likewise the dispersion of the bones of the Mammalia at the diluvian epoch, without their being at all rolled or broken, and in short, a number of other particulars which have no interest except when we embrace the whole of the question.

From this moment the surface of the earth must have been afresh subjected to the influence of the regular succession of the season. Then appeared the first spring time of the animals and plants which flourish in our days. The ice had retired to the foot of the Alps, and from their summits it began to receive fresh reinforcements. Speedily it reached its last retreats, where it is ever oscillating, sometimes gaining in extent, and forcing the blocks before it, and sometimes again retiring within narrower and narrower limits. At each step of ground they abandoned they left behind them, as the existing retreating glaciers now do, some of those long dykes of blocks which still exist in the Alpine valleys. Soon, too, the lakes themselves would melt, the waters would assume their present courses, the valleys of the Alps would be drained, and there remained no more ice, the product of former congelation, except on the summits of snow-clad mountains.

It would be a great mistake, therefore, to confound the glaciers which descend from the summits of the Alps with the phenomena of the epoch of that extensive ice which had preceded their existence.

The phenomena of the dispersion of erratic blocks, then, ought not any longer to be regarded in any other light than as one of the circumstances which have accompanied the vast changes occasioned by the fall of the temperatures of our globe previous to the commencement of our epoch.

The admission of an epoch of cold, which was so intense as to cover the earth to such distances from the pole with so vast a mass of ice as we have been contemplating, is a supposition which appears in direct contradiction with those well known facts, which shew a considerable cooling of the earth since the most remote period. Nothing, however, has proved that this refrigeration has been constant, and that it has occurred without oscillations. On the contrary, whoever has been in the habit of studying nature in a physiological point of view, will be much more disposed to admit that the temperature of the earth has been maintained, without any considerable oscillations, to a certain degree, during the whole period of any geological epoch, as is occurring in our own epoch, since it has diminished suddenly and considerably at the termination of each epoch, a change accompanied by the disappearance of the organized beings which characterized it, that it may rise again with the appearance of a new creation at the commencement of the following epoch, although at a lower degree of mean temperature than the preceding one, so that the diminution of the temperature of the globe may be expressed by the following line:—



Thus, the epoch of extreme cold which preceded the present creation, has only been a passing oscillation of the temperature of the globe, somewhat more considerable than the periodic refrigeration to which the valleys of our Alps are subject. It was attended by the disappearance of the animals of the diluvian epoch of geologists, as the mammoths of Siberia still attest, and preceded the uprising of the Alps, and the appearance of the animated nature of our day, as is proved by the moraines, and the presence of fish in our lakes. There was thus a complete separation between the existing creation and those which have preceded it; and, if the living species sometimes resemble in our apprehension those which are hid in the bowels of the earth, it nevertheless cannot be affirmed that they have regularly descended from them in the way of primogeniture, or, what is the same thing, that they are identical species.

By prosecuting these views, we may anticipate that the time will come when we shall be able to determine the geological period at which the sun began to exercise an influence upon the surface of the globe, so considerable as to produce the differences which now exist between the different zones, without these effects being neutralized by the influence of the internal heat, from which the earth must for a time have enjoyed a very uniform temperature over all its surface.

This theory, I fear, will not be adopted by a number of our geologists, who have settled and confirmed opinions on the point; but I anticipate it will be with this question, as with many others which assail old and established views. At all events, whatever opposition it may experience, it will remain true that the numerous new facts relating to the transport of blocks which I have pointed out, and which may be studied so easily in the valley of the Rhone and the environs of Neuchatel, have brought the discussion into wholly different ground from that on which it has hitherto been debated.

When M. de Buch for the first time affirmed, in opposition to the formidable school of Werner, that granite is of Plutonic origin, and that the mountains had been uplifted, what did the Neptunist say? At first he sustained his position alone; and it has only been by his defending it with the innate powers of genius, that he has made it triumph. It is happy for us, that in scientific discussion, numerical majorities at first have never decided any question.

The form into which I have thrown these observations will, I trust, banish all discussion on the subject at the present moment; and as, at the same time, I cannot hope that I have convinced every one of the truth of my views who have heard them for the first time, I propose the Geological Section as the most suitable for any discussion which may follow. I shall then make it my business to meet any objections which may be started; and, for the sake of truth, I earnestly solicit them.

Edin. N. Philos. Jour.

New Experiments on Light.

M. Arago read a note addressed to the Academy by M. Soliel, Jr., the object of which was to lay his claim to undoubted priority in all that relates to the construction of chromatic apparatus, intended to exhibit on a large scale the experiments of polarized rays of light through crystalline laminæ. For many years past, those philosophers who have paid particular attention to the optics of polarization, and among whom we will mention Messrs. Barbinet, Delezenne, Pelcet, Pouillet and Nœremberg, who have given their advice to this able artist, who has himself introduced many useful modifications in the arrangement of these experiments, which are so brilliant, and yet so little known. We ourselves can testify to the magnificent effects produced by these apparatus.

Last week, notwithstanding the inconvenience occasioned by the sun shining very dimly, Professor Pouillet exhibited these beautiful phenomena to the immense audience that is attracted to his course of natural philosophy. By the aid of this apparatus, which is both simple and reasonable in price, fifteen hundred persons were enabled to see and admire the system of admirable fringes produced by the interference of rays, an experiment attributed to Fresnel, and which is but a very happy modification of the colored rings of that master of all natural philosophers, Sir Isaac Newton.

The instruments of M. Soliel are equally adapted to the demonstration of the laws of double refraction, and of their identity with luminous polarization. By interposing crystalline laminæ in the path of rays, polarized by tourmaline, it exhibits on a large scale the brilliant complementary colours discovered in this case by M. Arago. This same crowd of spectators enjoyed the sight of the surprising results shown by crystals with one or two axes, which throw on a white screen, systems either circular, hyperbolic, or lemnisbates, curves tinted with a thousand colours, and of a brilliancy which no other process can even approach. Thus, all these magnificent images, obtained in France by Fresnel, Biot and Arago, and in England by Brewster, Herschel and Airy, are no longer cabinet phenomena, but may be exhibited to the most numerous assemblages.

We will add, that M. Soliel, jr., is not only the first who has made at Paris these beautiful apparatus, but he has discovered a very curious

effect produced by the dilatation of carbonate of lead on its optical axes and their superb curves. But these are things that must be seen to be appreciated, and all the descriptions in the world cannot give the slightest idea of the dazzling phenomenon of polarized optics.

We have been informed that our much esteemed fellow citizen, Professor A. D. Bache, was present at the experiment alluded to. Several specimens of M. Soleil's workmanship have been sent to this country, affording ample evidence of his ability, and we understand that Mr. Dobson, No. 108, Chesnut street, has received, and will continue to receive, orders for the apparatus made by him. Poulson's (Phil.) Daily Adv.

Progress of Civil Engineering.

On the comparative strength of the Cylindrical Tubes employed in high-pressure Boilers; with a plain practical rule for determining the relative strength of such tubes,—being in reply to a question of Mr. J. Hall in his letter to Mr. J. Seaward, of the 4th July, 1838.

To W. J. Hall, Esq.

(Copy.) Canal Ironworks, Limehouse, August 22nd, 1838.

Sir,—In your letter to me of the 4th July last, there was one question which I did not answer, viz., that respecting the difference of strength of plates employed in the construction of tubes: the reason of my not then replying to that question was, that it would have led into too much detail to be conveniently introduced in the then pending inquiry; the subject, however, being important, I now send you what I hope will be a satisfactory reply to your question. I also send you a few observations respecting the idea that steam boiler accidents are attributable to the explosion of gases. I propose to publish these documents, to which I presume, you can now have no objection.

I am, Sir, yours most obediently,

(Signed) John Seaward.

The strength of a cylindrical tube to resist an external pressure exerted on its outward surface, is a very different thing from the strength of the same tube to resist an internal pressure.

In the latter case, that is, when the force is exerted on the inside of the tube, and tending to burst or rend it asunder, the relative strength or power of resistance of the tube is very easily estimated; it is well known to be, under like circumstances, in the simple ratio of the thickness of the metal of which the tube is formed, and *inversely* as the diameter of the tube.

But in the other case, when the pressure is external, the strength of the tube to resist such pressure will depend upon very different principles:—it is generally supposed that the strength of a cylindrical tube under such circumstances must be immeasurably great; and there is no doubt that such is really the fact, provided the pressure is uniform all round the tube, and that the true cylindrical figure is strictly preserved; because in such case the tube is like a well-formed arch; it cannot be

destroyed except by the absolute crushing of the particles of metal one into the other, which is altogether improbable. But if the true cylindrical or circular figure is not preserved, and indeed if the deviation from the true figure of greatest resistance is ever so trifling, the principle of the arch is gone at once, it is then like an arch without abutments; and the tube under such circumstances, instead of being able to resist almost infinite pressure, will in fact be unable to resist a comparatively moderate pressure.

Now, practically speaking, it is almost impossible to form a tube that shall* be strictly cylindrical, or of any other figure of greatest resistance; the very weight of the material is sufficient of itself to destroy the true figure; the circumstance of the tubes of steam boilers being formed of metal plates with lap joints riveted together precludes the possibility of obtaining the true figure; moreover, in the case of horizontal tubes, as they are employed in steam boilers, the pressure is not uniform; for while the pressure on the upper part of a tube six feet in diameter may be only 13¾ lbs. upon the square inch, the pressure on the lower part of the tube will be nearly 16¾ lbs. to the square inch, because the weight of a column of water six feet high, has to be added to the pressure on the lower part of the tube; therefore the cylindrical, or circular, form is not in that case the true figure of greatest resistance; and it is not very likely that in the ordinary way of the business of boiler making, much care or correctness can or will be bestowed to the calculating, or afterwards in the making, of the tube, agreeably to the true figure of greatest resistance.

Moreover, if all the above difficulties be overcome, and the tube is formed according to the true figure of greatest resistance, there is little chance that it will long remain so, in the practical working of a boiler; the unequal contraction and expansion of the plates by being partially overheated and then suddenly cooled, accidents of constant occurrence, will cause the plates to be drawn and buckled, and thereby soon destroy the true figure. And it should be borne in mind that however trifling the alterations of form may be at first, yet the moment a slight alteration has taken place, the destructive change then goes on at an accelerated ratio. And here a very important distinction should be observed, which is, that when the force is exerted within a tube tending to burst it outwards, the force exerted will not induce any change of form such as to render the tube weaker; because if the tube was originally made tolerably near to the true figure of resistance, any change of figure which may afterwards take place, must be such as will render it in fact stronger—that is, supposing the metal plates to have some degree of elasticity—it will cause the tube to assume the figure of greatest resistance. But, it is not the same with a tube that supports an external pressure, because in this case, any change of figure must, demonstrably, produce a greater departure from the figure of greatest resistance, and thereby render the tube weaker and weaker; and this is a very important reason why a tube that has

* As a strong corroboration of this fact it may be stated that about fifteen years back some interesting experiments were made to ascertain the relative force which copper tubes were able to support internally and externally; the tubes were beautifully made, and as perfectly cylindrical as hands could form them, but it was found in every case that a much less force was sufficient to crush or collapse the tube than was required to burst it asunder.

been proved to a pressure of 30 or 40 lbs. to the square inch, may afterwards fail under a pressure of less than half that amount.

For the above reasons it is therefore clear, that a practical estimate of either the absolute or relative strength of tubes, supporting an external pressure, cannot be based upon the idea of these tubes being correctly formed agreeably to the figure of greatest resistance; the safe mode is to estimate the strength of the tubes by the capacity of the metal plates (of which the tubes are formed) to resist a transverse strain, in the same manner as we should estimate the strength of a flat plate, a bar, or a beam, the strength of which is known to be in the ratio of the square of the thickness or depth, in the direction of this strain.

Under this view of the matter, therefore, it would be correct to consider, that the strength of tubes under an external pressure would vary as the *square* of the thickness of the metal, but it is also clear that the strength will also vary *inversely* as the *square* of the diameter of the tube; because an increase of diameter not only increases the leverage, but also the absolute quantity of force in a like ratio.

But it would not be right to suppose that the absolute strength of curved plates in a tube is no greater than that of perfectly flat plates; this is not the case: there can be no question that the curved form enables the plates to sustain a much greater force than flat plates are able to support; and it is clear that the nearer the curvature of the plates approximates to the figure of greatest resistance, the greater force they will be able to bear; for although, as is stated above, the slightest deviation from the figure of greatest resistance destroys the principle of the arch, and thereby reduces the comparative strength of such tubes from almost infinity to a strength of very moderate limits, nevertheless curved plates will support a greater or less strain the nearer or the more remotely they approach to the true figure of greatest resistance.

It is therefore evident, that besides the capacity of resisting a transverse strain, there is another element of strength in tubes subject to external pressure; that is, the strength derived from the curvature of the plates; but, as this latter strength depends entirely upon the greater or less approximation of the curvature to the figure of greatest resistance, and as the degree of approximation will vary in every individual case, and will also be liable to rapid alteration in the same tube, it is clear that no general rule can be given for determining the strength thereby gained. And, indeed, this is not requisite in the present instance, because it is not intended to offer a rule for estimating the positive strength of tubes, but simply the relative strength of different tubes; which, as above stated, is, in like circumstances, as the square of the thickness of metal, and inversely as the square of the diameter of the tube. The positive or absolute strength of such a tube can only be known by actual proof, but this once known by the strength of other tubes may be estimated by the following rule :—thus, if a tube of 3 feet diameter and made of ½ inch plate is capable of sustaining a given external pressure, what will be the relative strength of a tube 6 feet diameter made of ¼ inch plate? Answer—the former is 16 times stronger than the latter.

But, in the case of the force acting inside the tube with a tendency to burst or rend it asunder, the strength of the tube will be as the thickness of the metal directly, and inversely as the diameter; therefore, if a tube is 3 feet diameter, and made of ½ inch plate, it will be 4 times as strong as a tube of 6 feet diameter made of ¼ inch plate.

The foregoing is a safe, easy, practical rule, and if employed by boiler makers in the planning of high-pressure boilers, I believe it will be the means of preventing many serious errors and fatal accidents.

Limehouse, August 20, 1838. JOHN SEAWARD.

Mech. Mag.

On the Cornish Engines. *By* THOMAS WICKSTEED, M. Inst. C. E.

In this communication, Mr. Wicksteed gives an account of several trials which he made on some engines in Cornwall. In a trial of the engine upon the Holmbush Mines, the water was delivered into a cistern and weighed, and the result obtained by an experiment was 102,721,323 lbs. raised one foot high with ninety-four pounds of coal: this was the quantity raised and delivered. The quantity raised does not, however, express the duty of the engine, which must be calculated according to the contents of the pumps and the atmospheric column, without any allowance for leakage. According to this calculation, the duty would be nearly 118 millions; namely, 117,-906,962 lbs. raised one foot high with ninety-four pounds of coal.

Another calculation is then given, founded on the law of Boyle, that the pressure of the steam is inversely as the space occupied. The steam was cut off at one-sixth of the stroke. and the temperature in the jacket was fully maintained by free communication with the boiler. The mean pressure of the steam being (on the above law) 17.66 lbs. on the square inch, the power of steam would be 271,658,700 lbs. Now, as the duty would be 117,906,992, we have 93,751,710 for the friction of the machinery, or about $7\frac{3}{4}$ lbs. per square inch; which is about two pounds more than the friction of a water-works pumping engine.

Mr. Wicksteed also made trial of a double engine at the Tincroft Mines working stamps, cutting off the down-stroke at two-fifths, and in the up-stroke at one-third. The duty of this engine was 56,525,072.

The coals consumed by the Tincroft engines amounted only to 1.57 lbs. per horse power per hour; whereas, in an experiment at Oldford, the quantity was 4.82 lbs. notwithstanding the additional friction in the former case of the mining engine. The consumption is stated by Mr. Farey, in his Treatise on the Steam-engine, for a double engine (Boulton and Watt,) at $10\frac{1}{2}$ lbs. per horse power per hour.

At the end of the paper are two tables, the one showing the gradual improvement of the steam-engine during sixty-six years, and the other the average duty of engines in Cornwall, for 1835 and 1836. The improvement has been progressive from 1769 up to the present time; and it appears, on the authority of Mr. John Taylor, that on comparing the water raised and the coals consumed from 1799 to 1828, at different times, there is a saving on the books of the mines proportionate to the improvements stated to have been made during these periods in the working of the engine.

Some discussion took place on the weight of the bushel of coals, Mr. Lowe stating that he had never known a bushel of Newcastle coals to weigh more than 84 lbs. Mr. Price stated, that the Welsh coal, which was chiefly used in Cornwall, was very heavy, and he had known a heaped-up bushel to weigh 101 lbs. The weight of the Newcastle coals was considered as varying from 80 to 84 lbs. Jour. Arts & Sci.

Camus on the Teeth of Wheels.

May 4th, 1768, died Charles Stephen Lewis Camus, the celebrated French geometrician, aged 69; author of a well-known Treatise on the teeth of Wheels, in which the best forms to be given to them for the purpose of machinery, were for the first time determined, on true mathematical principles. An English translation of this treatise appeared in 1806, with some additions from the translator's own pen, which evinced an unfortunate ignorance of the scope of M. Camus' demonstrations; and have been a fruitful source of error in English mechanical practice. Camus proved clearly that the epicycloidal part of a tooth, designed to act on another wheel or pinion, ought to be generated by a circle equal to *the radius* of the wheel or pinion with which it is to be engaged; while his English translator represented his meaning to be, that it should be equal to *the diameter!* Mr. J. I. Hawkins, who has lately favoured the public with a more correct edition of the treatise, states, that "many of our first-rate engine manufacturers" have been so misled by this misconception of the original translator of Camus, that they are daily "pouring into the market multitudes of cast-iron wheels and pinions, of various magnitudes, for cotton and other machinery, with teeth formed from the epicycloid of the diameter, instead of the radius of the opposite wheel, or pinion," and which must, in consequence, "wear out in a few years, instead of lasting the greater part of a century,—as many of them would do, if the teeth were formed on true principles. We regret to learn, from the same authority, that there are many wheel-makers who follow no rule of proportion at all in their formation. "In Lancashire, they make the teeth of watch-wheels of what is called the bay-leaf pattern; they are formed altogether by the eye of the workman, and they would stare at you for a simpleton, to hear you talk about the epicycloidal curve. These Lancashire workmen should be called the bay-leaf fanciers, because they cannot be bay-leaf copiers; since it is notorious that there are not two bay-leaves of the same figure. It is the opinion of Mr. Hawkins, that teeth accurately formed, either by epicycloid or involute curve, will endure the wear of a century, with less damage than teeth, as usually made, suffer in ten years.—*Mechanic's Almanac.*

Mech. Mag.

An account of an immense Chimney, recently built at Carlisle; with Suggestions for applying Chimneys, or Cones, of immense Height, to scientific purposes. By P. A.

"The immense chimney attached to the new cotton factory, now being built for Messrs. Peter Dixon and Sons, in Shaddongate, had the last stone placed upon it on October 24, 1837. It is one of the highest buildings in England, being 305 ft. from the ground; and for the purpose to which it is to be applied, is understood to be the highest erection in the world. It may be distinctly seen for many miles in all directions around Carlisle, and forms a beautiful object in the view of our city, from which ever quarter you approach it. The building is of the octangular form, and is built with brick, the angles being formed of stone. The base, which is built with fire-bricks, is 17 ft. 8 in. in width inside, and the thickness of the wall at the foundation is 10 ft. It tapers upwards to a width, inside, of 6 ft. 3 in.; and on the outside 8 ft. 9 in. Near the top

there is a cornice of stone, 7 ft. in depth, which projects 3 ft., and above this there are 8 ft. 3 in. of brickwork, surmounted by a coping stone one foot in thickness. The cornice gives a finished and classical appearance to the building; and the whole would be taken for some splendid national monument, rather than a mere conduit pipe for smoke. It is not a little creditable to Carlisle, that this magnificent work was entirely executed by a native of that city, a builder, a Mr. Richard Wright, who has completed it in a way to give the most entire satisfaction to every scientific man who has examined it. Considering its immensity, the work was completed in an incredible short period of time. The foundation stone was laid on Sept. 11, 1835, by P. Dixon, Esq.; the first brick was laid by Mr. Wright, on Sept. 17.; the last course of bricks, also by Mr. Wright, on Oct. 22, and the last coping stone on Oct. 25, 1836; thus completing the work in thirteen months. The erection was carried on from the inside, stages being erected as the work proceeded, and the workmen and materials being taken up in boxes prepared for the purpose, by a crab worked by four men; and it is gratifying to add that the whole was finished without any accident occurring to any individual engaged in it. Agricul. Mag.

Transactions of Institution of Civil Engineers.

June 13, 1837.—The President in the Chair.

Warming and Ventilating.

Mr. Oldham resumed the account of his system of warming and ventilating, and exhibited a model of his stove for heating the air. He was convinced that the expedient of forcing the air by mechanical means must be resorted to. He had raised the temperature of a room 24° F. in one hour; by spontaneous ventilation he could never obtain a temperature of more than 100° F., but by pumping in the warm air he readily obtained a temperature of 150° F., or 180° F.

Light House Lamps.

Mr. Horne called the attention of the Institution to a lamp which he thought would be peculiarly applicable to lighthouses, or wherever an intense light is required. The usual burners are an inch in diameter; now he had succeeded in producing a clear white light by a burner of half an inch in diameter. The excellence of the light is due to the complete combustion obtained, by making the area of the external equal to the area of the internal apertures. The air thus passes directly to the burner; there is a perfect uniformity of draught, the rapidity of which may be regulated by the height at which the burner is above the bottom of the glass, or chimney. The draught of air being thus supplied with perfect equality to both sides of the wick, a flat and steady flame of two inches in height is obtained, and the force of the draught is sufficient to prevent the flame from touching the edge of the burner, so that the edge is always clean and fit for use. Jour. Arts and Sci

Mechanics' Register.

New Material to be applied to Dwelling Houses, to render them capable of resisting Fire.

About the middle of November, 1837, the scientific world was somewhat startled by observing, in the newspapers, an announcement that a discovery had been made and perfected, of a material to be applied to dwelling houses, capable of entirely resisting the action of fire; that an experiment was to be made to prove its efficacy, at White Conduit House, Nov. 25, 1837; and that the presence of all parties concerned was requested to view the exhibition. It might have been supposed that the answer to this appeal would have been universal; and, as parties generally attend where there is nothing to pay, and they really are interested, that half London would have been present on the occasion. But, unfortunately, John Bull has had "Wolf!" shouted to him so often of late, mighty discoveries have turned out "such fantastic tricks," that he has grown very sceptical indeed. There was, however, a tolerably numerous party collected at White Conduit House on the day of experiment; some, of course, interested in its success; others, perhaps, equally so in its downfall. The material is, in appearance, a cement, and, like it, may be applied with the trowel, or with a brush in the manner of paint. Mr. Dewitte, the inventor of this composition, considers that it should be applied to the timber of a house while building, about a quarter of an inch thick; or it may be employed instead of the common plaster now in use, as it can be worked with equal facility, and polished and painted the same. Sufficient quantity has not yet been prepared to form any certain estimate of the expense; but he considers that the cost of preparing the whole of the timbers of an 8 or 10 roomed house would not exceed 30*l*. or 40*l*. For the experiment, two little wooden houses had been constructed; the one prepared interiorly, with the exterior just washed over to show the nature of the composition, and the other left in its natural state. These were filled with shavings and fired: the one not prepared was, of course, immediately one mass of flame; while the other resisted every effort to ignite it. It was delightful, at this moment, to watch the disappointment of the oppositionists, who afterwards took an unfair advantage of a neglect on the part of the proprietors. When the burning mass of the unprepared house was at its greatest heat, they busied themselves to turn it round close upon the other building, though Mr. Dewitte assured them that the exterior of the building was not prepared. After some time it began to burn, and they gloried in their triumph, until the one building, having burnt itself out, dropped to the ground, and discovered the side of the other partially burnt away, but with the inside coating and the rest of the building as perfect and unharmed as if it had never been touched, notwithstanding the furnace heat that had been applied to both sides of it. The persons assembled, among whom were Mr. Barry, and other eminent architects and scientific people, declared themselves perfectly satisfied of the complete success of the material: the only hope expressed was to see the experiment tried on a larger scale, when the proprietors shall be better prepared for it. Convinced of its perfect efficacy and value, I trust they will imme-

diately set about preparing a more extensive trial, to prove to those who are so anxious to throw cold water on the invention, that it is of no more use in stopping their progress, than it would be in stopping the progress of the flames when we shall enjoy the security of having our houses prepared with their composition.—*A. December*, 1837. Arch. Mag.

Discovery of ancient Piece-Goods and manufactured Stuffs.

It is more than a thousand years since Theodolphus, Bishop of Orleans, gave to Notre Dame du Puy en Velay a beautiful manuscript, containing the ancient Testament, the chronography of St. Isidor, and other pieces, the whole distributed into 138 articles. He made this gift in gratitude for his deliverance from the prison of Angers, where he was confined in 835. It was on Palm Sunday that year, while Louis Le Débonnaire was passing, that he began to sing a well-known Canticle, which the Catholic church has since then introduced into its ceremonies. This precious manuscript, in a state of perfect preservation, is to be seen in the archives of the Bishopric of the Puy en Velay, department of the Haute Loire. A portion of the manuscript is written on leaves of common parchment, in letters of red and black, intermixed with some of gold. The other portion is written on leaves of parchment, dyed purple, with letters of gold and silver, among which are observed ornaments of different kinds and different colours, designated the Byzantine style. The manuscript, which is remarkable for its beauty and its preservation, is still more remarkable for the *manufactured stuffs* of different descriptions which it contains. When Theodolphus composed his manuscript, with the intention of preserving the gold and silver characters from contact and friction, which, in time, would have tended to displace and obliterate them, he placed between each page a portion of the manufactured tissues peculiar to the era when he lived. These examples of the silk, and other pieces of goods of the time are thus curiously preserved. Till lately, little attention was paid to these tissues, which are principally of India manufacture, and which bear scarcely any analogy to the products of the modern loom. Some are Cashmere shawls of those patterns, which the French call *broucha* and *espouline*, and made in the Indian fashion, but with this difference, that they are limited to four colours, and demonstrate the greatest antiquity by the primitive simplicity of their colours and design. Others are crapes and gauzes, against the luxury of whose transparent tissues, the fathers of the church at that time so perseveringly fulminated their censures. The rest consist of muslins and china crape of exquisite beauty. The components of the majority of these tissues consist of goats' or camels' hair of exceeding delicacy and fineness. Like the manufactured stuffs of ancient Egypt, painted on the walls of its palaces and tombs, or substantially preserved amidst the envelopes of mummies, the designs are limited to four colours, which are in fact the four sacred colours of China, India, Egypt, and the Hebrew Tabernacle. Nevertheless, the Egyptian designs, which are identical with those of India, are many of them of exquisite beauty. The consummate skill of the silk and cotton manufacturers of ancient Egypt, 4000 years ago, the beauty and richness of their fabrics—and the little alteration which has taken place in the economy or machinery of the factories, as well as in

their product, has been recently demonstrated in the great work of Champollion. All the details of the silk and cotton factories of Egypt, under the Pharoahs of the 18th dynasty (which then monopolised the commerce of the world, and which sent a colony of weavers, from the overburthened population of Lower Egypt, to found Athens, and the subsequent civilization of Europe and this country) are laid open with vivid accuracy in that splendid work, and brought with all their startling analogies before the eye of the modern reader by the drawings from the temples, palaces, and tombs which it contains. It proves, indeed, that there is "nothing new under the sun." Mining Rev.

Probable duration of English Coal Beds.

In the fifth edition of Mr. Bakewell's *Introduction to Geology*, just published, there are some remarks on the duration of English coal, in addition to the observations made in the former editions of the work, which were quoted in evidence given on the subject in a committee of the House of Commons. After noticing the report of the committee, which estimated the annual consumption of coal in Great Britain at twenty-two millions seven hundred thousand tons, Mr. Bakewell proceeds to observe:

"The increasing demand for coal in the iron furnaces, and for steam navigation and steam carriages, will probably soon raise the quantity of coal annually consumed to thirty millions of tons, without adding to this ten millions of tons for coal left and wasted in the mines. A better idea of the consumption of coal will, perhaps, be formed by stating the quantity of coal burned in the furnaces of one house only (Messrs. Guest, of Myrther Tydvil, in Glamorganshire,) which is 970 tons per day, or 300,000 tons yearly; the amount of iron produced is 50,000 tons. This is a larger quantity of iron than was made by all the furnaces of Great Britain and Wales in the year 1760, and exceeds the quantity of iron at present made in Scotland, which in 1827 was only 36,500 tons. Surely when such an immense quantity of coal is required for domestic use and manufactures, it cannot be wise to encourage, or even to admit, the export of coal to foreign parts. The coal so exported, exclusive of that to Ireland and the colonies, is 500,000 tons annually. The duty on exported coal was entirely taken off in 1835, to satisfy the great landed proprietors in the north of England. I have before stated that the coal in Northumberland and Durham would at the present rate of consumption be exhausted in 350 years. An agent of one of the northern proprietors, in his evidence before the House of Commons, extended the duration of the northern coal fields to 1,727 years, estimating that there remained 732 square miles of coal in Northumberland and Durham still unwrought, and that the average thickness of the coal is twelve feet. In this calculation it seems to have been assumed that each workable bed of coal extends under the whole coal field, but many of the best and thickest beds of coal crop out long before they reach the western termination of the coal districts, or are cut off by faults or denudations. Professor Buckland, in his evidence on the subject, estimates the duration of the coal at the present rate of consumption to be 400 years. Professor Sedgwick, who is well acquainted with the coal strata of Northumberland and Durham, and had examined persons of great experi-

ence, gave his opinion respecting the duration of the coal in these counties as follows :—'I am myself convinced that with the present increased and increasing demand for coal, 400 years will leave little more than the name of our best coal seams;' and he further adds, 'our northern coal field will probably be on the wane before 300 years have elapsed.'"

Mr. Bakewell concludes his remarks on this subject by observing that his former anticipations, that improved methods of burning coal would be discovered, have been realised to a great extent; in proof of which he alludes to statements made at the last meeting of the British Association at Liverpool, of the use of the culm or dry coals of South Wales, by employing the hot blast, in smelting ironstone, which coal it had formerly been attempted to use for that purpose without success. "If," continues Mr. Bakewell, "the use of the hot blast is found everywhere to succeed, the consumption of coal in the iron furnaces will be reduced one half. It may, however, be doubted whether this reduction will equal the increasing demand for coal for steam-vessels and rail-road carriages, and the various manufactures of Great Britain." Farmer's Mag.

Steam Coach.

A few days since, Dr. Church's steam-coach went to Coventry with an omnibus attached to it, loaded with passengers, at the rate of twelve miles per hour. It ran up the hills at the rate of eight miles an hour. It came back with twenty-three passengers (three ladies,) without any accident. On Friday it proceeded to Meriden and back, also with an omnibus and passengers, and without accident. It will go to a more distant town early this week.—*Birmingham Gaz.*

On the Adulteration of Carmine; by C. G. Ehrenberg.

There occurs in commerce a kind of very fine coloured and very expensive carmine in the form of cakes, which owes its fine colour to an adulteration. Upon being made use of for ordinary painting no difference has been observed, but by the microscope it may be discovered that half of it consists of starch (wheat starch) which imparts to the finely divided carmine a clear ground and a brilliancy highly improving the appearance of the colour. When such carmine is mixed with much water, it diffuses itself throughout, and is for a long time suspended; but upon pouring off the water a white sediment remains similar to white lead. The sediment is starch. Besides this distinct form and size of an amilaceous body, when it is examined by its reaction upon tincture of sodium, it produces the well-known blue colour. This sediment when heated with water forms a paste. The addition of white lead is detected by its weight, but the addition of starch is not so easily discovered; but by means of the microscope the adulteration may be with certainty recognised, and confirmed by chemical examination. It may perhaps be interesting to the artist to know that few colours of this description mixed without an organic body, although pretty generally permanent, that are not in a damp atmosphere very liable to decomposition. In regard to its covering properties, starch differs considerably from white lead. It covers less on account of its transparency.—*Poggendorff's Annlaen, No.* 12, 1837. Lond. & Edin. Philos. Mag.

Pin-making.—Triumph of Machinery.

At Messrs. D. F. Taylor and Co's patent solid-headed pin manufactory, near Stroud, the machinery simultaneously performs the various functions, with little noise or effort while converting the rings of wire into pins, without the instrumentality of any manual assistance whatever; for while one combination of the machine is drawing forward, and straightening the wire, and cutting it to the required length, another apparatus is forming and smoothing the point, a third compressing and shaping the head, and a fourth detaching and drawing out the pin in its finished state, which falls into a receiver prepared for it; thus forty-five pins per minute are made by machines, while the whole plant is producing the almost incredible number of three millions two hundred thousand pins daily, exceeding nineteen millions weekly throughout the year. Mining Jour.

Number of Patents in France.

It appears, from authentic documents, that the following number o patents for inventions and improvements was granted in France from the 1st of July, 1791, the period at which they were first accorded, to the 1st of January in this year. The account is divided into the following periods:—During the Constitutional Monarchy, which lasted but three years, 67 patents were granted; during the Republic (fourteen years) 301; during the Empire (eight years) 606; during the Restoration, (sixteen years) 3383; during the Monarchy of July (seven years) 3018; total during the whole period 7375. Ibid.

Raising a large Stone in the River Tay.

An immense stone, long supposed to be a rock, and imbedded in the fairway of the channel, the top of it being immersed to the depth of five feet at low water, has been lately removed from its situation by operations continued during only five tides. The stone, of which the solid contents were 598 cubic feet, and the weight between forty and fifty tons, was raised by means of two dredging lighters, capable of containing twenty-five tons each, which were brought to the spot at low water. A hole of two inches diameter was previously made in each side of the stone, and plug-bats having been inserted, a chain was fastened to them, and thus when the tide rose, the stone was floated off its bed and conveyed ashore. Ibid.

Preserving Scythes, &c., from Rust.

To preserve scythes, sickles, reaping hooks, and other steel tools from rust after the season for using them, wipe them clean and dry, and hold them before the fire and keep drawing them backwards and forwards until warm enough to melt wax; then take some bees' wax and rub it all over. A halfpenny worth of wax will be sufficient for a scythe. Then put it in a dry place, but not warm; it needs no other covering. The usual method is to wrap a hay-band round; but in winter time this naturally contracts moisture, or the damp air strikes in betwixt the folds of the hay-band. Farmer's Mag

LUNAR OCCULTATIONS FOR PHILADELPHIA, JANUARY 1839.					Angles reckoned to the right or westward round the circle, as seen in an inverting telescope. ☞ For direct vision add 180° ☜	
Day.	H'r.	Min.	Star's name.	Mag.	from Moon's North point.	from Moon's Vertex.
21	6	20	Im. π Piscium	6	70°	90 °
21	7	3	Em.		1	32
26	8	12	Im. 49 *c* Aurigæ	6	79	24
26	9	34	Em.		279	253
26	11	18	N. App. ☽ & 54 Aurigæ 6, ☽ S. 1.′9			
27	13	46	Im. *c* Gem.	6	117	174
27	14	31	Em.		197	256
28	16	10	Im. γ Cancri	5	28	84
28	17	2	Em.		276	331
30	8	19	Im. 34 Leonis	6	21	329
30	9	5	Em.		293	241

Meteorological Observations for July, 1838.

Moon.	Days	Therm.		Barometer.		Wind.		Water fallen in rain.	State of the weather, and Remarks.
		Sun rise.	2 P.M.	Sun rise.	2 P.M.	Direction.	Force.		
				Inch's	Inch's			Inches.	
	1	70	80	29.80	29.85	E.SW.	Moderate.	.2	Cloudy—showery.
	2	70	85	85	90	S.W.	do.		Cloudy—lightly cloudy.
	3	72	88	85	63	W.	do.		Clear—do.
	4	70	90	80	80	S.W.	do.		Clear—do.
	5	74	91	80	80	S.W.	do.		Foggy—clear.
	6	72	83	90	90	N.W.	Brisk.		Clear—do.
☉	7	66	88	90	90	W.	Moderate.		Clear—do.
	8	71	89	90	90	W.	do.		Clear—do.
	9	74	92	86	86	W.	do.		Clear—do.
	10	78	94	80	86	W.	do.		Clear—do.
	11	78	92	75	75	W.	do.		Clear—flying clouds.
	12	74	85	75	80	N.W.	do.	.20	Clear—rain.
	13	64	78	90	30.00	N.E.	do.		Cloudy—clear.
☽	14	68	85	30.15	15	W.	do.		Clear—flying clouds.
	15	65	86	.05	00	S.W.	do.		Clear—do.
	16	68	88	29.85	29.80	S.W.	do.		Clear—do.
	17	74	86	85	85	W.	do.		Clear—do.
	18	71	87	95	95	S.E.S.	do.	.39	Flying clouds—rain.
	19	74	86	85	85	W.	do.		Clear—lightly cloudy.
	20	76	92	85	80	W.S.W.	do		Flying clouds—do.
⊗	21	79	87	70	70	W.N.W.	do.		Flying clouds—do.
	22	63	75	90	90	N.N.E.	do.		Flying clouds—do.
	23	60	78	30.00	30.00	S.W.	Calm.		Clear—flying clouds.
	24	61	77	00	00	S.W.	do.		Cloudy—do.
	25	67	84	29.80	29.80	S.W.	do.		Flying clouds—do.
	26	69	84	80	80	N.N.W.	do.	.48	Cloudy—fly. cl'ds.—rain in n'gt.
	27	74	88	85	85	S-W.	do.		Clear—do.
	28	72	93	90	90	W.	do.		Cloudy—do.
☾	29	77	92	88	80	W.	Brisk.		Clear—do.
	30	75	92	70	70	W.	Calm.		Clear—do.
	31	60	84	80	80	W.	do.		Clear—flying clouds.
	Mean	70 52	86.42	29.86	29.86			1.09	

	Thermometer.	Barometer.
Maximum height during the month.	94. on 10th.	35.15 on 14th.
Minimum " " "	60. on 23d and 31st.	29.63 on 3d.
Mean	78.47	29 86

// JOURNAL

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DECEMBER, 1838.

Progress of Practical and Theoretical Mechanics and Chemistry.

Remarks on some prevailing misconceptions concerning the Actions of Machines. By EDWARD SANG, Esq.*

In this paper I proceed to expose the fallacy of some prevailing notions concerning the actions of machines in general.

The fancy that machines are capable of generating power, though fostered by a very absurd proclamation from our government, is now almost entirely abandoned; and, except from two or three individuals ignorant of the history and of the principles of mechanics, we hear of no attempts at obtaining the reward offered for the perpetual motion. But another fancy differing less from this than it at first appears to do, is very generally entertained. We are perpetually told of the loss of force which arises from the obliquity of the actions of machines, and are called upon to examine cumbrous and expensive contrivances for rendering these actions direct, and for regaining, or even more than regaining, the force that has been wasted. If any arrangement of machinery were capable of destroying force, putting friction out of view, the inverse action of the same machinery would be capable of generating it.

The truth is, that every machine, however ill contrived, and however ill constructed, delivers over the whole, and exactly the whole, amount of force which put it in motion. Part of that force is expended in overcoming the friction of the rubbing surfaces, and in encountering the resistance of the air, while the rest goes to produce the particular effect which the contriver of the instrument may have had in view.

The geometric contrivance of machines, the arrangement of the parts so as to produce particular motions, has unlimited scope. But in a mechanical point of view, the inventor can, profitably, direct his attention only to two objects—economy in the material and labour necessary to the first con

* Read before the Society of Arts for Scotland, 9th January, 1833.

struction of the instrument, and the diminution, as far as is practicable, of the effects of friction. Were all friction avoided, it would be a matter of absolute indifference by what means the required changes of motion might be produced; it would then be of no moment whether we employed the reciprocating or the rotary steam-engine,—whether we used the crank, or the sun-and-planet wheel,—farther than the mere expense of workmanship is concerned. And we have no other criterion for estimating the superiority of one contrivance over another than the comparisons of the amounts of friction in the two cases.

These statements will be startling enough to persons half acquainted with the nature of machinery. "What," they will ask, "does the obliquity of the crank cause no loss of force? Is there no force wasted in producing the reciprocating motion of the beam in the steam-engine? And were they mere dreams that we entertained of immense improvements in machinery?" And when I assert, what is well known to every one acquainted with the subject, that there is no loss of force from the oblique action of the crank, that there is no force wasted on the reciprocating motion of the beam, and that the removal of friction is the only source of improvement in machines for transferring power,—I oppose the prejudices of multitudes who ought to be better acquainted with the principles of mechanics.

The principles which regulate the balance of pressures, and the movements of bodies, though discovered by man, are not of human invention; they are laws impressed by the Omnipotent upon the material world—laws to which matter yields an implicit, a perfect obedience. These laws are few in number, and the simplest language in which they can be expressed involves the very statements I have made. To exhibit, then, the truth of these statements would be to examine the reality of the fundamental laws of mechanics. To this examination I will not proceed, but will content myself with founding my investigations on the more common forms in which these laws are recognised. They naturally divide themselves into two classes: those which relate to the pressures of the acting parts during any momentary state of the machine, and those which relate to the properties of the machine considered as in motion. Those of the first, or statical, class, though at first sight very numerous, are summed up in one law, called the *principle of virtual velocities.* My first object will be to exhibit this principle in a clear light; not, indeed, as I would do in a scientific treatise on the subject, but in such a manner as appears to me to be best fitted for removing those prejudices, the existence of which has occasioned this paper.

When two weights balance each other by means of the wheel and axle, it is well known that they are to each other inversely as the diameters; but if the machine be turned a little round, the distances through which the weights move are directly as the same diameters,—so that, if each weight be combined with the distance through which it moves, the two results are exactly equal to each other. The descent of one pound through ten inches would, for example, be accompanied by an ascent of ten pounds through one inch, and thus whatever is gained or lost in intensity of pressure, as much is lost or gained in distance. It will be readily seen that the same thing is true of the straight lever, and of those combinations of pulleys which have their strings parallel: but in the case of the *inclined plane*, of the *bent-lever*, and, in general, of all machines in which the relations of the pressures are altered by a change in the position of the instrument, the application of the same rule is not so easy; and the slight difficulty that attends it has elicited the assertion, that the principle of virtual velocities is there at fault.

The relative motions of the different parts of a machine can easily be deduced from its geometric properties. The principle of virtual velocities enables us, from these motions, to compute the forces, and thus connects the geometric with the mechanical properties of machinery. This principle, one of the most beautiful and most pervading in nature, may be thus expressed :—

If the position of any machine be slightly disturbed, and if each pressure which has yielded, be combined with the distance through which it has yielded, and each pressure which has advanced, with the distance through which it has advanced, the sum of the one set of results will be exactly equal to the sum of the other set.

Now, in the case of the inclined plane, says the objector to the reality of this law, the weight raised and the weight which raises it move over equal distances. The motion of the weight is here mistaken for the distance through which its gravitation is overcome; its absolute motion, for its motion in altitude: now, it is well known that the force requisite to drag a body up an inclined plane, is to the weight of that body as the height of the plane is to its length; and therefore the principle of virtual velocity is here adhered to. This misconception is palpable and easily corrected; the motion of the machine does not alter the proportions of the forces. But, in the case of the bent lever, the error must be more involved, since it has crept from the work-shop to the lecture-room, and has been promulgated where sound knowledge and accurate ideas ought to have rewarded the labours of the student. The arcs, we are told, which the ends of the arms describe, are proportional to the lengths of these arms, while the balancing forces are not proportional, inversely, to the same lengths. Here, again, the absolute motion of the point of attachment is mistaken for the distance through which the pressure is overcome. If, however, the objector's capacity be not entirely exhausted by the immense profundity of this remark, he will reply, and with justice too, that even estimating the motions in the directions in which the pressures act, the rule does not hold good.

For the removal of this mighty difficulty I must summon all my strength. Accustomed to handle tools (I speak not for myself only, but for every devotee of true philosophy), accustomed to handle tools admirably adapted for facilitating researches of this nature, and now called upon by the circumstances of the case to lay these tools aside and to venture on the question with unappareled hands, I cannot altogether divest myself of repugnance to the task. To render it, however, more inviting, I shall make the question as general as possible, and without confining myself to this, or any other, individual case, apply my remarks to those machines generally, in which the forces vary with the positions of the parts.

Conceive that for a given position of such a machine, the pressures are so arranged as to balance each other, and then let the machine suffer a displacement. If this displacement be considerable, the equilibrium will be materially disturbed, and the estimate of the motions, far from giving information concerning the original forces, would commingle the means for determining the forces in all positions between the first and last, and would rather be the basis for determining the conditions of the mean state, than of either of the extreme ones. However small may be the displacement, still will there exist an error in the estimate; yet the more minute the displacement, the more inconsiderable will be the error, because there will exist the less difference between the two extreme states of the machine. In order, then, to compute the pressures accurately, we must determine the

proportions which subsist between the motions of the parts, supposing that these motions are infinitely small. I know of no other method for effecting these computations than that contained in the Differential Calculus, or in the more abstruse but more satisfactory theory of Lagrange; and, although the name of fluxions be a bug-bear to thousands, it is absolutely impossible without its aid, to advance beyond the threshold of mechanical investigation. The advocates for mental indolence may urge that the statical properties of many machines may be examined without the aid of the fluxional calculus. Such is, indeed, the case, and these machines and such methods of calculating concerning them may afford lessons to the beginner; but from such processes few, if any, general conclusions can be drawn, while the instant that motion is contemplated, all these resources fail.

The principle of virtual velocities, such as I have defined it, holds true of all machines, even though subjected to the retarding influence of friction; and is applicable not merely during a momentary state, but also to the motions of machines. Denoting by the word *force*, the result of the combination of a pressure with the distance through which it acts; if the sum of the accelerating forces be just equal to that of the retarding ones, the quantity of motion in the machine will be unaltered, but if the two sums be unequal, then will the speed be changed. Now, in almost all machines the forces and velocities are subjected to periodic variations; the method then of computing the change in velocity consequent upon a change of force must be clearly understood, ere we obtain any information as to the general properties of machines in motion.

The great proposition which connects the statical with the phoronomic properties of machines is this; that the change in the entire quantity of motion is proportional to the difference between the separate amounts of the accelerating and of the retarding forces; the quantity of motion being estimated by combining each moving mass with the second power of the number which represents its velocity. Now, I have already said, that whatever be the nature of a machine for communicating force, the amount of force delivered during a minute instant of time at the one end, is exactly equal (throwing out of view the friction and the weights of its parts) to that communicated during the same instant to the other end; so that the same change is produced in the entire quantity of motion, whether the force be applied directly to the moving mass, or whether it act upon it through the intervention of machinery. This most important principle I shall endeavour to illustrate by example.

Borrowing my illustration from the steam-engine, I shall suppose one in which the piston acts directly upon the fly-wheel, by means, say of a double rack working alternately on each side of a toothed wheel. Here it will not be denied that the accession to the quantity of motion in the machine during a half-stroke will be exactly what is due to the agency of the pressure of the steam upon the piston through the whole length of the cylinder, less, of course, by all the amount of all the retarding forces during the same period. Contrast this with what happens in the common steam-engine. Let the connecting rod be so nearly in a line with the crank, that a pressure of one hundred pounds on the piston exerts only a pressure of one pound in the direction of rotation; then does it follow, from the principle of virtual velocities, that if the piston advance minutely in the cylinder, the extremity of the crank will advance one hundred times as far along its path. The quantity of motion generated in the machine then will be what is due to a pressure of one pound acting through one hundred times the advance of

the piston, or, what is the same thing, to the pressure of one hundred pounds acting through that advance itself. The same thing is true for every other minute motion of the piston, and, therefore, the whole amount of motion communicated to the machine through the crank is exactly equal to that communicated to it by means of the double rack and toothed wheel, or by means of any other contrivance whatever.

In the two arrangements, however, which I have contrasted, the motion will be divided among the parts in very different proportions. The manner of that distribution vitally affects the economy of the machine. The entire quantity of motion is not and cannot be concentrated in the fly-wheel; the piston and all the other moving parts must have their share of it. In the engine with the double rack, the piston and its appendages possess, from the beginning of a half-stroke until the end of it, their full velocity. During the half-stroke, therefore, none of the force of the steam is expended in generating the motion of the piston; but just when the piston has reached its extreme position, its whole velocity must be extinguished and generated in the opposite direction, and the consequence is, that the extreme tooth of the rack will receive a blow as if from a hammer as heavy as the piston and all its appendages, and moving with twice its velocity; and although no loss of force would arise from this action, its continued repetition would tear the machine to pieces. In the case of the balanced crank-engine, on the other hand, during the first part of a half-stroke, the velocity of the piston and beam is gradually increasing; at the middle their velocity is the greatest; and during the latter part it gradually decreases. In the first quarter revolution of the crank, the force of the steam is thus partly expended in producing the motions of the piston, beam, and connecting rod; but in the second quadrant, when these motions are being retarded, the force necessary to accomplish this retardation communicates an equal accession of motion to the fly-wheel. Still, then, is the whole force of the steam expended in overcoming the friction, and in producing the particular effect which may be wanted; still is there no force lost on account of the obliquity of the actions, or of the reciprocation of the movements; and still is the diminution of the friction the only source whence increased effectiveness can be obtained.

I do not expect that what I have just said will be sufficient to eradicate misconceptions so prolific of crude and abortive schemes. The failure itself of the contrivance is often inadequate to convince its inventor of the fallacy of his ideas. Fortified in his ignorance by the fancy that theory is a different thing from practice, there is small chance of his yielding to the arguments of one whom he considers as a pure theorist. The fashion of the day, which puts diffuse and indistinct notions in the place of true learning, which cries for science leveled to the meanest capacity, or as I would translate it, to the most confirmed indolence, fastens these prejudices more firmly on the minds of the half instructed. Were the evils of this fashion to rest with those who turn to philosophy for relief from the ennui of idleness, they might have been passed over in silence; but when they reach that class to whose usefulness extensive information is essential, their removal becomes an object of the highest importance. It would not be proper for me, in the present paper, to venture into the depths of this subject; but the connexion between what is called *popular science* and many of those mistakes which are so current, is too immediate to permit of remarking on these without casting a glance, at least, to their fertile source.

Were the laws which regulate the phenomena of the universe, laws of

human invention, and did they involve contradictions and absurdities, then, indeed, with some propriety might the cry be raised, "They are too abstruse, they are too difficult; let us have them simplified and leveled to the meanest capacity." Level these laws, and they are no longer the laws of nature; the true method of seizing them, is to nerve the mind with higher powers; to infuse into it an exalted ambition, and to come to the attempt prepared for long-continued and strenuous exertion. Would effeminacy pave the way to the white summit of the Jungfrau? or, had your parlour hearth-stones been brought from the summit of Ben-Lomond, think you that your delighted eyes could thence have wandered over lakes and mountains? No. He who would scan the wonders of Nature, who would contemplate the wisdom, the beneficence of her works, and would use his acquirements for the advantage of his race, must give himself enthusiastically to the pursuit, and must scorn to turn from the difficulties in his path. Perseverance will crown his exertions with success; and the elevation of his mind, the calm and ineffable delight which accompanies the acquisition of knowledge, will, a thousand times, repay all his exertions. From the throne of science he will descry connexions and arrangements and sympathies among the passing events, and turning, with his colleagues, to the yet unscaled heights, he will emulously pursue the career of discovery. The present is a spirit-stirring time; on all hands have discoverers been at work; from north and south has the hitherto unpassed barrier been assailed, and already have the signals of the workmen on either side been descried by their fellow-labourers. Elated by the prospect of speedy success, they now redouble their exertions, and expect ere long to re-assemble on a higher platform. The science of mechanics has long reared its head proudly over its fellows. Under its efficient guidance, its indefatigable votaries have estimated the weights and motions of the heavenly bodies, and carried into the highest department of the science an exactness almost superhuman. Now, however, the sciences of chemistry, galvanism, and magnetism, advance rapidly to take their stations by its side, and promise to rescue from the charge of inconsistency the great laws of mechanics.

The precision which reason assigns to mechanical phenomena, the precision which these phenomena exhibit when the planets, launched in unfilled space, perform their mighty evolutions, fails us, when we lower our contemplations to terrestrial objects. Here the perfection of nature seems to be marred, the traces of absolute exactitude to be effaced, as if some evil genius had thwarted the Almighty in his design, and sowed confusion where order was intended. All motions on the surface of the earth are soon extinguished, and there was no wonder that men, in the infancy of science, drew the conclusion that matter possessed a reluctancy to move. It required a mind of no common energy to burst the shackles which education and early experience had combined to rivet, and to oppose its solitary strength to the bigotry of false religion and false philosophy. Unaided, Galileo long maintained the contest, and although at last the man fell, his doctrine was victorious. Since that time friction has been recognized as the antagonist principle, which opposes, and invariably succeeds in extinguishing, motion, which creates errors in the results, and uncertainty in the practice of mechanical operations. Far, however, from being the cause of the imperfection of machines, friction is essential to their very existence. Not a fastening would be secure, not a screw would hold were it not for its pervading agency. Without friction this world would have exhibited a scene of indescribable confusion. Conceive for a moment, its influence suspended, and

where would be progressive motion? how would we climb the steep, how, even, would we walk along the plain? The mountain masses, rushing to the plains, and not arrested even there, as now, but hastening along with undiminished speed, would leave no spot for vegetable, no safety for animal life: though dashed to powder by repeated blows, each particle would yet move onward, and chaos would be realized. Far, then, from friction marring the general design, it, itself, is one of the most admirable and most beneficent provisions which nature's God has made for the felicity of his creatures.

When we glance over the vast fields of modern science, and contemplate the harmony that reigns among the known laws, when we consider the ease with which geometry is engrafted on arithmetic, the perfect acquaintance with geometric laws which is exhibited in the contrivance of the mechanical ones, we cannot imagine that the law of friction militates against or annuls one really existing law of nature. Chemistry has acquainted us with the permanency and indestructibility of matter; mechanics has taught us that the entire amount of momentum estimated in any given direction, is absolutely fixed, and has indicated that, except where friction and chemical changes interfere, the total amount of motion in the universe is unchangeable. The recent discoveries in galvanism and electricity shed a new light upon the subject.

The combustion of the coals, the chemical union of the carbon with the oxygen in the furnace of the steam-engine generates motion; that motion is extinguished partly by friction, and partly in effecting the disintegration of bodies; and it now seems more than probable that this rubbing and this subdivision of matter induces a state, and communicates that state to surrounding objects, which afterwards goes, in some distant quarter perhaps, to reproduce chemical changes preparatory to a new evolution of the like forces. Small, indeed, as that change must be when absorbed in the general mass, it is not on that account, the less real. The mass of stone that has been torn from the quarry, and fashioned into this splendid town, is minute indeed, yet, undoubtedly, that transference has retarded the rotation of the earth, although our senses, aided by every contrivance of science and art, be utterly unable to discern a trace of the change.

While, then, we zealously strive to improve our machines, and to remove the friction from the inefficient to be concentrated on the working parts, let us not repine that, after all our exertions, we are still compelled to resign a tithe of our labour to that influence under which alone it is possible for us or our machines to exist, and let us console ourselves with the thought, that, though our exertions be lost to us, nature has taken care that they conduce to the maintenance and well-being of the general system.

Edin. N. Philos. Journ.

Improvements in Steam Boilers and Saving of Fuel in Manufactures.

Accounts having appeared in the *Scotsman* and various other respectable journals, on the authority of a scientific gentleman of great eminence, of a discovery in heating and evaporating fluids, which, as it promises to lead to important results, we hasten to lay before our readers, referring them at the same time to the advertisement in another column. They are in substance as follows:

The discovery consists in the employment of air highly heated, to assist

in generating steam in boilers, and in the process of evaporation in general in manufactures. The air is heated by being carried through iron boxes, or troughs placed in the current of the flame, behind the bridge of the furnace. The current of the air through the trough effectually protects the metal from being injured, even in fires so fierce as to vitrify brick and speedily to melt cast-iron in juxta-position with the trough. When thus heated, the air is carried in straight tubes through the water in the boiler, entering at the back, and passing off at the front. Being unmixed with the smoke, it does not soil the tubes, which, therefore, rapidly transmit the heat; and the air in its passage is effectually cooled down to the heat of the water. In this state it is conducted under the ashpit, thus feeding the fire with air at the heat of 212 degrees, from which, as repeated analyses have shown, that it has parted with little or none of its oxygen, important benefits arise; the fire is saved the necessity of heating up to that degree the whole air which passes through it; and the process of combustion is otherwise beneficially promoted. The ashpit is closed with doors, and the draught of the chimney establishes and keeps up the requisite current of air for the purposes of combustion, through the heating trough, the cooling tubes, the fire, and the flues. The additional heating surface thus gained by the tubes in the boiler, exceeds the fire surface, or bottom of the boiler, by fully one-half.

This process, which is sufficiently simple, and the efficacy of which is vouched for by the gentlemen referred to, whose knowledge, experience, and skill, are of the highest rank, promises to be productive of very important results, both as regards steam-boilers, and manufactures where heating and evaporating fluids is required, such as distilling, brewing, dying, the making of paper, salt, sugar, and many others, especially in those in which the vessels containing the fluids are not placed on the fire, or where steam is now used for that purpose.

The saving of fuel was upwards of 33 per cent. in steam boilers, whose ordinary average performance is about 6.22 pounds of water to the pound of Newcastle coal, not deducting the ashes. In the other processes it must be commensurate with the quantity of the steam that escapes uncondensed; thus dissipating in the atmosphere a vast amount of heat derived from the fire, because, where air is used, no part whatever of its heat is lost, whereas, when any of the steam escapes uncondensed, all its latent heat is lost. Thus, 250 cubic feet of low-pressure steam per minute, of about 1200 degrees (temperature and heat), directed through tubes in seventeen cubic feet of water contained in a wooden trough placed on the ground, scarcely raised the water to 212 degrees, and could not make it boil, nearly the whole steam passing off in vapour when the water attained that heat. But 100 feet of air per minute, at about 600 degrees, caused the water to boil violently, and the same was the result when the quantity of air was successively reduced to one-half, and even much less.

The least consideration of the very many millions of tons of coal consumed in these processes, will show the importance of the discovery in this point of view. There are others, especially as connected with steam navigation, which, in other lights, are equally important. The free tonnage for goods or passengers will be enlarged, or the length of the voyage increased, in proportion to the diminished stowage and weight of coals and water in the boiler; for the boiler, as well as the fuel, and also the funnel, may be lessened one-third. The diminution of the boiler also tends to add to its strength; and the increased facility in transmitting to the water, the heat derived from the fire, arising from the greater heating surface afforded by

the tubes, must still farther operate to prevent the imminent hazard arising in marine boilers, from the exertions of the engineman to generate steam more rapidly. The only way in which this can be accomplished at present, is by forcing the fire of the furnace. By the intensity of the heat thus produced, many parts of the boiler and flues, especially those where incrustations have been formed on the bottom, or where the water spaces have been too much contracted, become overheated and consequently weakened, and ultimately destroyed. Whatever tends safely to accelerate and facilitate the transmission of the heat to the water, obviously diminishes the necessity to contract the water spaces, and the temptation to force the fire. It is also important that the heat which is absorbed by the air, is withdrawn from the fire at the point at which it is fiercest, and is, by a proper distribution of the tubes, applied to the portions of the water farthest removed from the direct influence of the fire.

If it shall be found, as we have reason to expect, that hot-air used in the furnace will enable anthracite coal to be burned, it is not easy to see to what extent of saving this discovery may lead in steam navigation; this coal being vastly more powerful than any other.

It is no small advantage to the public, and no slight recommendation of this plan, that not only does it not interfere with any other improvements for economy of fuel now in use, but it is rather an addition to, and may be used in conjunction with them, but also that it may be easily adapted to almost any existing furnaces, boilers, and processes of manufacture, at an expense altogether trifling, contrasted with the benefit resulting from its use.

With regard to the license for its use, the patentee has wisely adopted the plan so successfully followed by the late Mr. Watt, in making the charge proportionate to the saving of fuel. We observe that he proposes to charge only one-third the value of the fuel saved in all cases.

We understand that a company is about to be formed, by which the benefits of this discovery will be immediately communicated to the eastern part of Scotland, by the sale of a portion of the income of the patent, and devolving on the company the management and control of the patent; and that the patentee is ready to treat for a similar arrangement for other districts, on terms highly advantageous to the company. It were well that after due inquiry, means should be speedily resorted to for securing the benefit of the improvements on this plan, for this great capital, and other districts of England. Mining Jour.

This application of hot air to the furnaces of steam boilers is ascribed by the Editor of the Mining Journal in another part of his paper, to Mr. William Bell, of Edinburgh, and its value is said to be confirmed on the authority of experiments by Dr. Fyfe. G.

Bell's Improvements in heating and evaporating Fluids.

With the view of putting the principle of his invention to the test, Mr. Bell made numerous experiments on a small scale, in which it was invariably found that there was an increase of evaporation when the hot air was used. In experiments afterwards conducted by Dr. Fyfe, at the request of the patentee, on a larger scale, and with an apparatus of a totally different construction, viz. a small wagon boiler, with flues through the centre—similar results were obtained. Many long trials were lately conducted under

the superintendance of the same chemist, at the manufactory of Mr. Morton, engineer, Leith Walk, who also superintended, on an eight horse engine boiler, with a flue through the centre, and surrounded also by flues. The ordinary average performance of this boiler, without the use of hot air, was 6.22 pound of water steamed off, to each pound of Newcastle coal. These, therefore, may be considered as trials applicable in practice, and in them the results were equally satisfactory. Of course, these results varied according to circumstances. In the most unfavorable, there was, when the hot air was propelled through the boiler, a saving of fuel to the extent of 17 per cent.; but the general result amounted to from 20 to 30 per cent. Taking the average of all the experiments, the saving was 23 per cent. In the apparatus last used, by which the above results were obtained, there is an iron box, situated immediately behind the fire, connected in front with a circular blower, by which air is propelled into the box, and from which it is conveyed by tubes through the boiler, where it gives off its heat to the water. By this means the air has been heated to 600 and upwards, in which state it enters the water, and, traversing it, comes off at 212, or thereabouts, having communicated the heat, necessary for raising it from 212 to 600 or 700, to the water, and by which the evaporation was increased.

It must, however, be evident that, by the transmission of air in this way, part of the heat must be lost; because it is given off from the boiler at the temperature of the boiling water. With the view of saving this, the patentee has adopted means by which the hot air, after having done its duty in the boiler, may be returned under the ash pit, so as to serve for combustion; thus, along with his own method, also applying a well-known principle, of aiding combustion by a hot-blast, and by which it is well known, there is a manifest advantage. When the hot air was thus returned into the ash-pit, it was found that the saving of fuel was greater than has been already stated; on an average, it amounted to upwards of 33 per cent.

In trials which have been made, also under the superintendance of Dr. Fyfe and Mr. Morton, by passing the hot air in tubes through water, but without mixing with it, and under which there was no fire, it was found that the water was made to boil, and was kept boiling. On one occasion, the steam from a low-pressure engine boiler, passed in pipes through a large trough with water, did not act so powerfully as 100 feet of air, at about 600 degrees of heat, propelled through the fluid per minute. Now, from this boiler there must have passed about 250 feet of steam in the same time.

We are aware that objections may be, and indeed have been, urged against this plan. It is supposed that the box in which the air is heated will soon be destroyed, by the great heat to which it is exposed; but that is not the case. It seems to be protected from injury by the constant current of cold air introduced into it; the box employed in the trials at Mr. Morton's, though it has been long in use, is not in the least injured. Another objection brought against the plan is, the power required for propelling the hot air through the system of tubes, and by which it is of course supposed that a part, or even the whole of the saving effected, must be consumed, and consequently that there can ultimately be no saving. But this objection, though plausible, does not hold true. Those who have advanced it seem to have had in their minds, at the time, the propulsion of the hot blast in furnaces for smelting iron; but the cases are very different from each other. In the latter, the air has to pass through a mass of semi-fused materials in the furnace, and consequently requires a considerable power to do it; but in the latter the air has merely to travel through tubes, in which it meets little or no resistance,

so that the power required is trifling. But even this is not necessary; for, in those cases where the hot-air is to be returned into the ash-pit for combustion, the ash-pit is closely shut, and it has been proved that the draft up the chimney is all that is required to maintain a constant and adequate current of air through the heating box; so that, by this mode of using it, no additional power whatever is required.

It may also perhaps be urged, that, as the air has to pass over hot iron, its oxygen may be abstracted, and that thus its utility for the purposes of combustion may be expended or destroyed. In all trials, however, that have been made, it was found that this was not the case. The air has been analyzed by Dr. Fyfe, and never found to have lost more than three or four per cent. of its oxygen, while in other trials, there was little or no change in its composition. Lond. Mec. Mag.

Chinese mode of Printing.

"The mode of printing adopted by the Chinese is of the simplest character. Without expensive machinery, or a complicated process, they manage to throw off clear impressions of their books, in an expeditious manner. Stereotype, or block printing, seems to have taken the precedence of moveable types in all countries, and in China they have scarcely yet got beyond the original method.

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"The use of wooden blocks has not been without its advantages; among which we may enumerate speed and cheapness. The first part of the process is, to get the page written out in the square or printed form of the character. This having been examined and corrected, is transferred to the wood in the following manner :—The block, after having been smoothly planed, is spread over with a glutinous paste; when the paper is applied and frequently rubbed, till it becomes dry. The paper is then removed, (as much of it as can be got away,) and the writing is found adhering to the board, in an inverted form. The whole is now covered with oil, to make the letters appear more vivid and striking, and the engraver proceeds to his business. The first operation is, to cut straight down by the sides of the letters, from top to bottom, removing the vacant spaces between the lines, with the exception of the stops. The workman then engraves all the lines which run horizontally; then, the oblique; and, afterwards, the perpendicular ones, throughout the whole page which saves the trouble of turning the block round for every letter. Having cut round the letters, he proceeds to the central parts; and, after a while, the page is completed. A workman generally gets through one hundred characters a day, for which he will get sixpence. A page generally contains five hundred characters. When the engraver has completed his work, it is passed into the hands of the printer, who places it in the middle of a table; on one side is a pot of liquid ink, with a brush; and on the other a pile of paper; while, in front, there is a piece of wood, bound round with the fibrous parts of a species of palm, which is to serve for a rubber. The workman then inks his block with the brush: and taking a sheet of dry paper, with his left hand, he places it neatly on the block; and seizing the rubber with his right hand, he passes it once or twice quickly over the back of the paper, when the impression is produced, the printed sheet hastily removed, and the workman proceeds with the next impression, till the whole number is worked off; and thus, without screw,

lever, wheel, or wedge, a Chinese printer will manage to throw off 3000 impressions in a day. After the copies are struck off, the next business is to fold the pages exactly in the middle; to collate, adjust, stitch, cut and sew them; for all of which work, including the printing, the labourer does not receive more than ninepence a thousand. The whole apparatus of a printer, in that country, consists of his graves, blocks, and brushes; these he may shoulder and travel with, from place to place, purchasing paper and lamp-black as he needs them; and, borrowing a table anywhere, he may throw off his editions by the hundred or the score, as he is able to dispose of them. The paper is thin, but cheap; ten sheets of demy size, costing only one halfpenny. This, connected with the low price of labour, enables the Chinese to furnish books to each other for next to nothing. The works of Confucius, with the commentary of Choo-foo-tsze, comprising six volumes, and amounting to four hundred leaves, octavo, can be purchased for nine-pence; and the historical novel of the *three kingdoms*, amounting to 1500 leaves, in twenty volumes, can be had for a half-a-crown. Of course, all these prices are what the natives charge to each other; for all which Europeans must expect to pay double.

"Thus books are multiplied, at a cheap rate, to an almost indefinite extent: and every peasant and pedlar has the common depositories of knowledge within his reach. It would not be hazarding too much to say, that in China there are more books, and more people to read them, than in any other country in the world."—p. 103.

Many of the praises here bestowed by Mr. Medhurst on the Chinese practice, must be taken with very considerable allowance. We cannot very well see why the attribute of "speed" as well as "cheapness" is to be ascribed to it. From his statement it would appear that a workman is occupied five days in producing a block for a single page of a common size. What sort of "speed" is this compared to that attained by the use of single types? And by what miracle could the Chinese, with their "speedy" method, manage to get out such a sheet as the double *Times*, in the course of a few hours? The thing is clearly impossible; and Mr. Medhurst would therefore have done better not to adduce rapidity as one recommendation of a process, which, in its very nature, must be slow. The "cheapness" is also rather problematical. True, the expense of engraving a page does not strike the English reader as any way alarming; but engravers are not to be had every where for sixpence a day. The process is only comparatively, not positively, cheap,—cheap, not from its inherent simplicity, but merely on account of the cheapness of labour in China, from the overstocked state of the labour market. Did the Chinese language admit of the introduction of movable types, (which a former Emperor once attempted,) and were the Chinese acquainted with the art of type-founding, our system would be far cheaper than their own, it being recollected that where wood engravers are to be had for a sixpence a day, type-founders must be procurable at a proportionate sum. To make the matter clear, let us only imagine the reverse to take place,—the introduction of the Chinese method into England. Supposing our artist be as expert as his Eastern prototype, and to be satisfied with six shillings a day, (no very extravagant wages it will be owned,) here are at once thirty shillings for the labour alone of "setting up" a single page—and that, too, a page only of the extent of one of our *columns*, reckoning every "character" to represent a word. This, indeed, is allowing nothing for the casting of the types, but this may be set against the value of the Chinaman's block, which, it should be borne in mind, will serve for only one page, while

the more expensive type may be distributed and set up again *ad infinitum.*

The mode of obtaining the impression is a different matter altogether; in this case something is likely to be gained from an observation of the Chinese fashion. Our ideas are so bound up with "the press," that it appears to us an essential of "the glorious art;" and we are so often in the habit of toasting "the Liberty of the Press," that it seems almost sacrilegious to compass and imagine the printing of a book without its aid. Yet the Chinese have printed for ages without having heard of "the Press" at all! The great simplicity of their process is a most striking feature, while even the limited experience which has been had of it in England, (where a similar method is adopted for taking engravers' proofs, &c.) is sufficient to demonstrate that it is compatible with the highest degree of typographical excellence. Would it not be worth the while of some of our ingenious mechanics to turn their thoughts in this direction? Ingenuity has been lavishly bestowed on the improvement of the printing press, until the maximum of power in that engine may be presumed to be attained. Why not try invention on another tack, and apply English skill in machinery to the perfecting of a mode of printing on the Chinese plan, where the impression is obtained by a gentle friction, instead of a tremendous direct impression? Could this be achieved, it would probably be one of its not least important results, that type might be made of a much less valuable material than at present, and by a much less expensive and elaborate method. At any rate the attempt is worth making,—though it would probably be necessary to commence by introducing a much softer texture of paper than that now used, and, perhaps, to print, like the Chinese, on one side only.

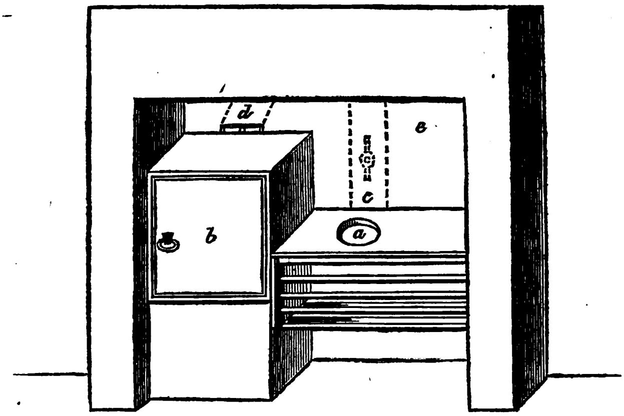
Mr. Medhurst is again, towards the conclusion of our extract, rather too solicitous to exalt the cheapness of Chinese literature. The number of volumes to be had for a few pence may seem rather startling, but then he should have stated, that the volumes of Chinese books are by no means of such substantial dimensions as our own. For instance, the six volumes of Confucius, it appears, contained altogether only four hundred leaves, (that is, four hundred *pages*, being printed on one side only,) containing only about half as much as a common English volume of the octavo size. Nine-pence certainly seems low enough for this quantity of matter, but then this sum of nine-pence in China, be it remembered, forms the whole earnings of an artist for a day and a half; so that, all things considered, it is evident that our own standard works are sold at a much lower rate than this much-vaunted and inconceivably cheap edition of the great Chinese classic. If books, therefore, are sold in China for "next to nothing," what are we to think of the price of such commodities at home? It would be as well for Mr. Medhurst to avoid such mystification for the future.

Ibid.

Notice of an improvement of a common Fireplace; by M. Saul.

I herewith send you a plan of a common fire-place, which is found to have several great advantages over the old plan. From an inspection of the drawing, I presume it will be understood that on the grate is fixed a cast-iron plate with a circular aperture in the centre at *a*. It is $8\frac{1}{2}$ in. in diameter, which just takes a common tea-kettle, and answers well for other sized pans, as I find it is of no moment, the pan being larger than the aperture. By this plan the heat is confined in the grate; and by several exper-

iments, I have proved that anything will much sooner boil in this closed grate than in an open one; and it also throws out a greater heat in the



room, and prevents smoke; and, when the fire is not wanted for cooking, there is a plate to cover the aperture. It also consumes less fuel, and is a sure remedy for a smoky chimney. When an oven is also made in the same fireplace, as seen at *b*, the whole heat is made to pass upon the oven by turning the damper in the flue, *c*, which is behind the iron plate, when the smoke is carried up the oven flue (*d*). When the oven is not wanted, the flue *d*, is closed with the damper, and then the smoke rises through the flue, *c*. A small aperture is made on the top of the iron plate at *e*, to admit any smoke that may arise when putting on the fuel, or changing the kettles or pans.

This plan may be adapted to any grate now in use. It is only necessary to get a cast-iron plate the size of the grate. It is to rest on the top bar of the grate, and on the brickwork on the back; and a small aperture is to be made for the smoke to escape, and an iron plate fixed in front, to prevent the smoke from entering the room. Arch. Mag.

Action of Sulphate of Ammonia upon Glass; by R. F. Manhand.

A mixture of muriate and nitrate of ammonia strongly corrodes glass, particularly glass containing lead. Sulphate of ammonia has precisely a similar action. As this salt upon being heated parts with a portion of its base, it may be considered as a salt with excess of acid. When heated in a glass vessel to the temperature of 316° Fahrenheit, it begins to melt: up to 600° Fahrenheit, it does not suffer any further changes; at this temperature ammonia is driven off, sulphate and sulphite of ammonia sublime and the glass vessel is much corroded. The whole inner surface of the glass becomes dim, while the sulphuric acid combines with the potash, and probably the ammonia as it is driven off combines with the silicic acid. The glass generally flies to pieces and in the centre is much acted upon; the fragments are fused with difficulty, and are recognised by the blowpipe as sulphate of potash.

I have often further remarked that the watch glasses (containing lead) which I am in the habit of using, to dry substances in vacuo over sulphuric acid, after from two to four weeks become covered with numerous flaws, and small splinters may be easily separated from them. I have not been able to de-

tect any loss of weight, therefore the appearance cannot be due to the abstraction of any air contained in the glass, as Bischof, who observed something similar, surmises. I have never observed the same action to take place upon the glass of the air-pump, or upon other glass.—*Poggendorff's Annalen*, 1837, *No.* 12. Lond. and Edin. Philos. Mag.

On a fossil stem of a Tree recently discovered near Bolton-le-Moor; by Dr. Black, F. G. S.

Communicated to the Geological Society, May 9, 1838.

The rock in which this fossil was found, occurs in the middle of the coal-measures, about 50 yards beneath a six-feet bed of coal, and it rests upon another bed four feet thick. It consists of three strata of argillaceous sandstone dipping from 15° to 18° to the south-west, and amounting in all to about 40 feet in thickness. The upper portion of the fossil stem was discovered about thirty feet beneath the surface of the rock, and the lower end extended to within 5 or 10 feet of the adjacent bed of coal. It was inclined 18° to north-east, or in an opposite direction to the sandstone strata; and, when first laid open, it appears to have been about 30 feet in length. but at the time it was examined by Dr. Black only 12 feet remained *in situ*. The upper end of this portion was 15 inches in diameter, and the lower 9 inches. The whole of the exterior of the stem was singularly striated, and irregularly furrowed, as if by compression; and it was coated with a layer of coal, which evidently occupied the place of the bark. The interior of the stem is stated to be composed of a dark, hard, argillo-ferruginous sandstone, having a specific gravity of 2.9. A Sternbergia, about an inch in diameter, extended along the whole length of the stem, and in some parts appeared to be half imbedded in a groove in it. This connexion of the two plants was Dr. Black's principal object in making the communication to the Society, not having previously observed a similar occurrence, nor having heard that it had been noticed elsewhere by other collectors. He is of opinion that the Sternbergia was not accidentally allocated with the larger stem, but that it was, while living, a parasite, and in this respect resembled the mighty creepers of the existing tropical regions. Ibid.

Progress of Physical Science.

South Staffordshire Coal Fields; by Frederick Burr.

This remarkable district, "the present ascertained area of which is scarcely equal to a hundred square miles," is chiefly situated in "a small isolated patch of Worcestershire which lies within the county of Stafford and some distance to the north of the general boundary of the former county." Its principal town is Dudley, which is built mostly of brick, and contains about 23,000 inhabitants who are in a great measure supported by the adjacent mines and mineral works.

This coal field possesses one very striking peculiarity in a geological point of view, the millstone grit and carboniferous limestone are entirely wanting, and the coal, in the absence of its usual substrata, rests upon a more ancient formation of limestone. It differs also from our more northern coal fields in containing comparatively few beds of sandstone, and those generally thin and of but small importance, the great mass of the formation being made up of shale beds, in which many seams of coal and ironstone occur, several

of the former being of great thickness and value, while some of the iron-stone measures are equally productive.

The general dip of this coal field is towards the south, or rather the south-east, but it exhibits several remarkable curvatures and fractures of the strata, which are not only of much geological interest, but of great local importance, as bringing the beds of coal nearer to the surface, and allowing the underlying formation of limestone to be easily worked, although in its natural position so deeply seated as to be scarcely accessible for those purposes to which it is so largely applied. The main or ten-yard coal is situated about the middle of the series, which presents in all eleven seams of coal, five being above, and five below the main bed.

The principal curvatures and contortions of the strata will be readily understood on reference to the accompanying sketch, representing a section of the Staffordshire coal field from north-east to south-west, of which it will convey a good general idea, although not pretending to local accuracy or detail. It will be seen that the general continuity of the coal measures to the southward, is interrupted by two lines of elevation, one occurring near Walsall, the other near Dudley, and the underlying limestone is in both cases brought to the surface. Two anticlinal axes are thus formed, the most prominent and decided is however that at Dudley, which extends completely across the coal field, separating it into two great troughs or basins. Each of these lines of elevation is marked by an eruption of basalt, but that to the south of Dudley is by far the most extensive and important. The numerous faults occurring in the district, are of course not attempted to be shown in this little diagram.

In proceeding briefly to describe in a descending order the various strata existing in the vicinity of Dudley and the surrounding coal field, they may be enumerated as follows:—recent or diluvial deposits—new red sandstone—coal measures—Dudley limestone, and basalt.

The diluvial deposits consist of beds of sand and gravel, the former loose and incoherent, the latter often much indurated. These deposits appear to be indifferently spread over both the coal strata, and the surrounding new red sandstone, and are too general in their occurrence to require any particular notice. At Moseley and Edgbaston, near Birmingham, they cover the new red sandstone, between Oldbury and Wednesbury they are spread over the coal strata, and to the north of the coal-field extensive deposits of this kind may be seen between Lichfield and Rugely. The diluvial deposit near Oldbury, is of a very remarkable character, it consists of loose sandy soil, containing besides the pebbles usually found in such situations, *rolled masses or boulders of coal.* This deposit is with much justice considered in the neighbourhood as indicating the site of an ancient river. It may probably be referred to some ancient rush of water, occasioned by the altered drainage of the neighbouring country, at one of the great periods of elevation marked by the basaltic eruptions of Dudley and Walsall.

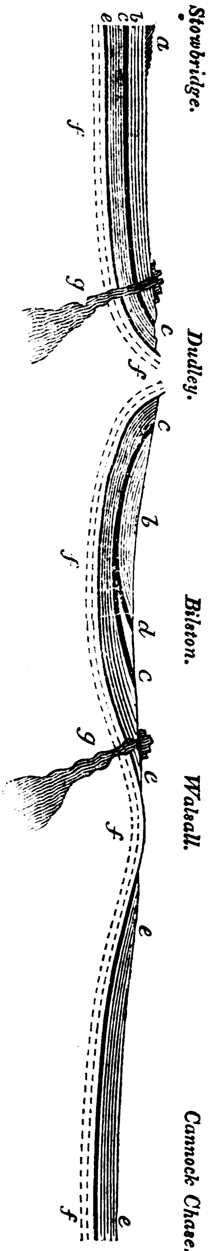
The most striking feature which this coal field presents, is the extraordinary bed, or rather assemblage of beds, called the "ten-yard coal," which, as before observed, is confined to the southern half of the coal-field, and there forms the principal object of mining operations. The ten-yard coal is most extensively worked in the neighborhood of Dudley, which lies nearly in the centre of it, and where it is found on both sides of the anticlinal axis formed by the limestone range, the depth from the surface being generally about 120 yards.

The depth of this bed of coal varies much, however, in different situa-

tions, being influenced both by its general dip, and the intervention of faults It may be stated as usually occurring at from one to two hundred yards below the surface, which is the general limit of the depth of the collieries. In some of the older mines it was found, however, at a much less depth toward its outcrop, but these are now nearly exhausted. It may be mentioned, as a remarkable fact, that coal is stated to have been obtained near Wolverhampton, by *open cutting*, probably the only instance of the kind which has ever occurred in the kingdom. The ten-yard coal presents the very singular phenomenon of the successive deposition of carbonaceous matter, with scarcely a trace of the intervening earthy deposits which usually form such thick masses between the seams of coal. We have here, therefore, a striking contrast to the usual circumstances attending the deposition of coal, the carbonaceous matter having been (if the expression may be allowed) in excess, while the earthy matter usually so abundant appears to have been almost entirely wanted.

The ten-yard coal is made up of twelve or thirteen seams of various qualities, each having its distinct local appellation among the miners, and separated from the others by a thin parting of shale. The structure of this remarkable bed will, however, best be understood by reference to the annexed sketch taken from Mr. Thomas Smith's valuable Chart of Sections of the Staffordshire and other coal fields. As regards the quality of the coal, it is deserving of notice, that the best is found occupying the middle of the bed and about half its entire thickness, while the seams both above and below are very inferior, although extensively used in the neighbouring iron furnaces. The variety of circumstances under which the deposition of coal was carried on even within a very limited area, receives an admirable illustration from the singular phenomenon which characterises the crop of the ten-yard coal towards Bilston, and which is provincially termed, the "flying reed." The two upper seams of the bed become gradually

SECTION ACROSS THE SOUTH STAFFORDSHIRE COAL-FIELD.



a, new red sandstone. *b*, beds above the ten-yard coal. *c*, the ten-yard coal. *d*, the "flying reed." *e*, beds below the ten-yard coal. *f*, Dudley limestone. *g*, masses of basalt.

The two dotted lines show the two beds of pure limestone, which alone are worked for lime.

separated both from the lower seams, and from each other, by the gradual interposition of thin, wedge-like masses of rock, which at first form merely narrow partings between them, but increasing in size to the northward, at length present several beds of shale and sandstone, interpolated between the three beds of coal into which the ten-yard coal is then divided. The two upper beds, termed the "flying reed," rise quickly to the surface, but the principal mass of coal lying beneath them, crops out still further to the northward. Large portions of this rich bed of coal are now exhausted; and great subsidences of the surface have consequently taken place above the excavations, as is often apparent from the cracked and inclined position of the houses and other buildings.

The beds lying above the ten-yard coal are but little worked, both from being thin, and from their proximity to a much more abundant deposit. The beds lying below it, are, however, worked very extensively in the northern part of the district, and have an average thickness equal to that which is generally observed in the north part of England. The Staffordshire coal differs considerably from that of Newcastle, being of a less bituminous nature; it burns very readily, making an excellent fire, and leaving a residuum of white ashes. When used for the purpose of making gas it is found to afford from thirty to thirty-five per cent. less from a given quantity than the Newcastle coal; and its heating power is considered to be inferior in nearly the same proportion. From the peculiar nature of this coal the loss of weight sustained in coking is very great; it is generally, indeed, estimated to amount to full one-half.

The ironstone, although found in many of the strata, is chiefly worked in two thick beds lying below the main or ten-yard coal, and is the common clay ironstone of the coal measures. It generally occurs in septaria-like nodules, imbedded in soft clay, forming seams from one to four yards or more in thickness. Iron pyrites occurs very abundantly in some of the beds of coal, and good specimens of columnar clay-ironstone are found near Wednesbury. About three tons of ironstone are used on an average in the furnace to obtain one ton of pig-iron.

The shale and argillaceous beds, provincially termed "clunch," as previously observed, constitute the principal mass of the Staffordshire coal formation; the former exhibit the usual characters of coal shale, but are frequently more compact and indurated, assuming the appearance of some of the older shales—a circumstance, no doubt, attributable to the proximity of the basaltic mass, which may be presumed to underlie the greater part of this coal-field, since in addition to the erupted masses already noticed, it is found at a great depth in dykes and wedge-form masses in many of the coal mines. Some of the argillaceous beds of the coal measures afford excellent fire-clay, and are extensively worked for this purpose, but the most valuable is that found near Stourbridge, from which the celebrated Stourbridge fire-bricks are made.

The sandstone is usually argillaceous, and is provincially termed "binds," or when much indurated, "rock binds." The small development of this rock appears to indicate a more quiet disposition than that which took place in the northern coal fields, although occasional intervals of disturbance, probably contemporaneous with the eruptive movement, of the underlying basalt, are clearly indicated by some of the sandstone beds, and a coarse conglomerate, expressly called by the miners "rough spoil." The sandstone beds afford in some situations excellent fire-stone, as at Gornal near Dudley, at Tipton, and other places. This material is extensively used in the

construction of the iron furnaces, the hearths of which are formed of it, the upper part being built of fire-bricks. The entire thickness of the various beds constituting this coal formation is generally considered as somewhat exceeding three hundred yards.

The faults which traverse the Staffordshire coal field are, as before noticed, very numerous; the strata are, indeed, so much shattered and dislocated, that in any new trial much uncertainty exists as to the depth at which the seams of coal will be found. Many of the faults occasion a throw of more than fifty yards, and one near Bilston amounts to ninety or a hundred. Saline springs rise in some places from the coal measures, and their situation, I have been informed, coincides with that of the faults, a circumstance calculated to throw much light on the origin of the rock salt deposits of the adjoining county of Worcester.

The highly interesting formation of limestone, which underlies the Staffordshire coal field, and which from its prominent appearance at Dudley has received the name of the "Dudley limestone," although here placed in immediate contact with the coal strata, is well-known to be of much higher antiquity, its true place in the order of stratification being below the old red sandstone, where it forms one of the members of the series of ancient shales and limestones, formerly vaguely grouped together in the class of transition rocks.

The Dudley limestone is the oldest stratified rock which is known in the Staffordshire coal field, and is so deeply seated below the coal, that had it not been raised to the surface by powerful volcanic agency, but little would now have been known of its existence, while the surrounding mineral district, in the absence of this limestone as a flux for smelting the ironstone, could hardly have attained its present wealth and importance. This formation appears at the surface in two places only, though seen in the coal mines in other spots also.

There is a considerable variety both in the texture and appearance of the limestone under consideration, some of the beds being compact and subcrystalline, while others are loose and earthy. At Dudley the colour is whitish or greyish, and the two strata of hard, pure limestone which have been so extensively worked for supplying the iron furnaces, are separated by softer thin argillaceous beds, of a marly nature, termed by the quarrymen "bavin." It is chiefly in these beds that the well-known fossils which characterise the series are found. The limestone beds which are exposed at Sedgeley, are of a blackish colour; and similar characters are exhibited to the east of Walsall. The fossils contained in the Dudley limestone are remarkable for the beauty and the delicacy of their preservation; they consist of *trilobites* (especially the *Calymene Blumenbachii,)* *terebratulæ, corallines, encrinites, &c.* converted into limestone, and projecting in fine relief from the upper surface of the strata. A single specimen will not unfrequently present a perfect series of the most characteristic fossils, so thickly are they studded on the surface of the rock. It is therefore evident that at the time the limestone strata were deposited, the superincumbent ocean teemed with animal life to a most extraordinary degree, while from the appearance of the strata, and the fossils they contain, it is certain that their deposition was slow and uninterrupted, and that the period of volcanic eruption which subsequently prevailed had not then commenced its action. During this period of tranquility it would not, however, seem improbable that a quiet, but copious deposition of calcareous matter from *thermal springs* may have had a considerable influence in producing a formation of

limestone so prolific in animal life, and this may have been the first effec of that powerful volcanic energy, which at a subsequent period broke forth with such violence as to convulse and shatter the surrounding coal field in the manner we now find it.

The limestone is very extensively worked both in the neighbourhood of Dudley and Walsall, especially the former, where its inclined position at the surface renders it more easily accessible than in most other places. The outcrop of the beds having been long ago exhausted by open cutting, recourse has been had to subterranean working, and excavations of vast magnitude have been formed upon the two strata, which furnish limestone of sufficient purity for use. They are about twelve yards each in thickness, and separated by a considerable mass of the thin marly strata before noticed; the two workable beds are generally termed by the miners the "blue lime." The excavations somewhat resemble the workings of a coal mine, but from the great thickness and indurations of the beds, they are far more lofty and spacious, presenting immense vaults or chambers, with massive pillars to support the roof. They may be seen to great advantage below the Castle Hill at Dudley, where an underground canal of rather more than a mile in length has laid open all the limestone beds in succession; nor can a more striking scene be well imagined than is presented by this remarkable spot, which is so readily accessible as to be examined without difficulty even by those who are least accustomed to subterranean explorations. At the Deepfield mines near Bilston, the upper bed of limestone has been reached by sinking completely through the coal measures, and is there ten yards in thickness.

Although of little value compared with the formations previously noticed, the basaltic masses which protrude through the Staffordshire coal field afford objects of equal interest to the geological traveller. Commencing a little south of Dudley, the principal mass of basalt extends in a south-easterly direction to the village of Rowley, a distance of about three miles, forming a range of hills, which, although elevated eight or nine hundred feet above the sea level, is not very prominent or abrupt. The basalt itself is generally concealed by the soil, but is well exhibited in several quarries which have been opened upon it. In one or two of these quarries the columnar structure of the rock, although not perfectly developed, is distinctly marked, but in others it is hardly discernible. The mass of basalt forming the eminence called Pouck Hill, about two miles from Walsall, appears, however, to have been formed under circumstances much more favourable to the development of the columnar structure, than that of Rowley Hills, as it forms a series of very perfect prisms, which are arranged with considerable regularity, either in a horizontal or slightly inclined position. The range of basaltic hills to the south of Dudley is considered to form a vast overlying mass, connected with some great eruptive dyke, which probably also extends, although at a considerable depth, below the limestone hills. I have been informed that the coal has in some places been worked underneath the basalt, but never to the point of junction.

The basalt of Staffordshire presents the usual characters of this rock, it is of a deep, black colour, hard, compact, and slightly crystalline, affording a plane and tolerably even fracture. Several specimens which I have tried affect the needle very perceptibly, showing that a portion of the iron contained is in the state of the protoxide—a circumstance which appears rather singular in a rock which must have been exposed to a degree of heat so

intense and long continued.* The basalt, as far as I have been able to observe it, appears to be tolerably homogeneous, the joints or separations of the rock presenting the usual ochry appearance. The purposes for which the quarries have been opened are chiefly paving and mending the roads, and the basalt is familiarly termed by the quarrymen, "Rowly rag," a name derived from its principal locality. I believe some attempts have also been made to use the basalt in making the common green bottle glass, a purpose for which this material does not appear by any means inapplicable.

The quantity of iron made in Staffordshire in the year 1827, has been stated from official documents, at 216,000 tons, the produce of ninety-five blast furnaces. In the following year (1828), the quantity of iron is stated in Marshall's Statistics, at 219,492 tons, also the produce of ninety-five furnaces, twenty-five being then out of blast. For the ten years which have since elapsed, I am not aware that similar statements have been made, and from the well-known fluctuations in the iron trade, the quantity must have been varied much. It is generally considered, however, that about a hundred furnaces are now in blast in Staffordshire, and if we take the weekly produce of each as being, on an average, forty-five tons, which will probably be near the truth, it will give a total yearly produce of 234,000 tons of pig iron. During the great demand for railway and other iron, which prevailed two or three years ago, it is probable that the quantity may even have exceeded this amount, while, in the intermediate period of depression, it must doubtless have fallen much short of it.

As regards the quantity of coal produced in Staffordshire, our means of information are less perfect, no statement of the amount having, I believe, ever been published. From the quantity consumed in the iron furnaces, it will, however, be possible to form at least an approximate idea of the total amount. If we assume that, on an average, six tons of coal are consumed in producing one ton of pig iron, and this certainly does not exceed the fact, we shall have a consumption of 1,404,000 tons of coal annually in the smelting of iron alone. Of the 234,000 tons of pig iron yearly produced, probably about two-thirds are converted into bar iron, thus requiring a vast additional consumption of coal. Every colliery has one or more steam-engines for winding the coal; most of them an engine for drawing water also, and in these engines the coal is most profusely, or, rather, indeed, extravagantly used. When we add to these demands the consumption of the dense population of the neighbouring district, of the manufactories of Birmingham and other places in the vicinity, the quantity employed for burning lime, and other minor uses, it will not, perhaps, be an exaggeration to double the quantity used for the iron furnaces alone, and to state the quantity of coal produced by the South Staffordshire coal field, at little short of 3,000,000 tons per annum.

The quantity of limestone quarried annually by processes more laborious and expensive than are generally required in obtaining this mineral, is not undeserving of notice. It is generally considered that about one ton of limestone is required in smelting a ton of iron, thus giving a consumption of limestone in the iron-works alone of more than 230,000 tons per annum. If to this we add the quantity used for mortar and cement, for manure and other purposes, it will be evident that the produce of limestone must equal, if not exceed 300,000 tons per annum.

The fire-clay obtained at Stourbridge and other places, and the gritstone

* This property is not, however, peculiar to the Staffordshire basalt.

quarried for making the bottoms of furnaces, would form another item in the subterranean produce of the mineral district under consideration, but of the annual quantity of these no estimate can be formed. Enough has, however, been stated to show the extraordinary wealth of the South Staffordshire coal field, the present ascertained area of which, it may be further observed, is scarcely equal to a hundred square miles.

The number and condition of the population concentrated upon this small but important mineral district, and deriving their support entirely from its subterranean produce, is a subject fully as interesting as any which have been touched upon in the present sketch, but which can only be briefly and imperfectly noticed here. Stourbridge, Hales Owen, Dudley, Wolverhampton, Wednesbury, and Walsall, rank as towns, and with the important neighbouring villages of Bilston, West Bromwich, Oldbury, Tipton, Sedgeley, King's Swinford, Rowley Regis, Darlaston, and Willenhall (scarcely inferior to them in size), possess an aggregate population considerably exceeding 200,000 persons. Places of minor importance are, of course, very numerous, and, together with the scattered houses, must contain a large population. Even Birmingham, with its 150,000 inhabitants, might fairly be reckoned as forming part of the population of the South Staffordshire mineral district, for, although not located upon it, the prosperity, almost indeed the existence of the town, has been dependent on its proximity.

It would occupy a far greater space than can be here devoted, even to glance at the varied and ingenious species of industry by which this vast population is supported, all taking their rise from the subterranean produce of the district under consideration. At Dudley, nails and various articles of hardware are manufactured; at Wolverhampton locks and articles as steel; at Walsall, bits, stirrups, spurs, and articles of hardware; while at Birmingham, the emporium of the neighbourhood, the manufacture of trinkets, jewelery, fire arms, and every species of hardware, whether delicate or massive, ornamental or useful, is carried on to an extent unparalleled in any other part of the world, and justifying the expressive epithet of Burke, who called it the "toy-shop of Europe." In addition to the characteristic manufacture of every town within the district, the universal occupation of making nails should not be forgotten. The business of the nailor is almost peculiar to Staffordshire, and unlike most other manufactures, is carried on with patriarchal simplicity in almost every cottage throughout the southern part of the county.

The progress of this active scene of universal industry is greatly facilitated by the numerous canals which traverse the country in all directions, converging to Birmingham as their common centre, and by means of the Grand Junction Canal, communicating even with the Metropolis. The operations of the mines and furnaces are, of course, facilitated by the innumerable local train-ways, thus reducing, by all the powers of art, the cost of transporting the bulky produce of the soil to the spots where it is required. Staffordshire, however, unlike most other mineral districts, exports but little of her raw produce, nearly the whole being finally worked up on the spot, and exported in a manufactured state.

It will be seen that the vast industrial fabric at which we have now so briefly glanced, is entirely dependent for its existence on the enormous supply of coal produced by the neighbouring district; and the richest deposit of this mineral, the "ten-yard coal," has already been spoken of as partially exhausted. The question naturally arises, then, how long will the present supply continue, and the district be maintained in its present flourishing

condition? To this important query a general answer only can be given. It is certain that the quantity of coal contained in the district has been greatly reduced, both by actual consumption, by unnecessary waste, and by unfortunate subterranean combustion: on the other hand, however, it is probable that the beds below the main coal may yet contain a large reserve in the northern portion of the coal field, and even that they may hereafter in some cases be worked with advantage in places where the upper coal is now nearly exhausted; while (which is far more important) the peculiar geological features of the country indicate the probability of a great extension of the coal measures beyond their present known limits. It will be seen that this coal field, unlike many others, is not bounded by more ancient rocks which crop out from below, and positively circumscribe its limits. It is, on the contrary, surrounded by the new red sandstone, below which a large portion of it dips, extending for an unknown distance, and existing at an uncertain depth. To this great extension of the coal field, we may look, then, for a supply for future ages, when the present known beds shall have become exhausted; and the trials which have been made within the last few years show that we shall not look in vain. It is understood that this interesting subject has been very ably investigated by Mr. Murchison, and will be fully treated on in his forthcoming work on the "Silurian Region;" any further notice of it here would, therefore, be superfluous.

Much greater economy in the working of coal has, fortunately, of late years been introduced in Staffordshire, and even the satisfactory prospect just noticed does not diminish its necessity; for, although there is every probability that the district itself may continue to be productive of minerals, long after the present working tract is exhausted, still the deterioration of existing property of every kind must be immense, whenever the population and the seats of manufacturing industry shall gradually be obliged to settle in new localities, in consequence of the opening of new mines, and the exhaustion of the old ones. It must also be remembered that the present mineral tract can never return back to its primitive condition of an agricultural district—encumbered with mouldering piles of masonry, with enormous masses of slag and cinder, the produce of the iron furnaces, and with heaps of refuse from the mines, its aspect, when abandoned, will resemble that of an extinct volcano, and its value will be literally reduced to nothing. Without wishing to lay an undue stress upon the future, it would, perhaps, be well were considerations like the foregoing to have some little weight in our coal districts, at least so far as to prevent unnecessary waste of that valuable substance, which, however abundant in this country, is still positively limited in its quantity, and absolutely incapable of reproduction.

Mining Rev.

On the Composition of certain Mineral Substances of Organic Origin; by JAMES F. W. JOHNSTON, A.M., F.R.SS. Lond. and Ed., F.G.S., Professor of Chemistry and Mineralogy, Durham.

Ozecerite from Urpeth Colliery, near Newcastle-upon-Tyne.

The attention of chemists and mineralogists has for several years past been drawn to a species of fossil wax found in Moldavia, in sufficient quantity to be employed for economical purposes, and to which the name of

Ozercerite has been given.* This substance is of a brown colour, of various shades, has the consistence and translucency of wax, a weak, bituminous odour, sometimes a foliated structure and conchoidal fracture, and can be reduced to powder in a mortar. In burning, it emits considerable light, and is said to be used for the manufacture of a species of candles.

The chemical and physical proporties of this substance were first examined by Magnus (*Ann. de Chem. et de Phys.* lv., p. 218) more lately by Schrotter (*Bibliothèque Univ.*, May, 1838); and most recently by Malaguti (*Ann. de Chem.* lxiii. p. 390); who agree in representing it as a mixture of several substances, differing in their physical properties, yet possessing the same ultimate chemical constitution.

The occurrence of a fossil body, possessing many of the characters of Hatchetine, and having much resemblance to the fossil wax of Moldavia, in a coal mine in this neighbourhood, where no doubt could exist as to its origin, has afforded me an opportunity of adding to our knowledge of this class of mineral compounds, while it seems to indicate pretty clearly their common organic origin wherever they may occur.

In driving through a *trouble* in Urpeth Colliery, at a depth of about 60 fathoms from the surface, this substance was found in cavities near the sides of the trouble, and sometimes in the solid sandstone rock; it occurred in considerable quantity, and was sufficiently soft to be made up into balls by the workmen.

The specimen sent to me by my friend Mr. Hutton, of Newcastle, is soft, unctuous, sticking to the fingers, and giving a greasy brown stain to paper; semi-transparent; by transmitted light, of a brownish yellow colour; by reflected light, yellowish green and opalescent; having a slight fatty odour, more perceptible when the substance is melted. It fuses at 140° Fahr., attains its greatest fluidity at about 160°, and begins to boil at 250°. It distils without apparent decomposition, the colourless oil which passes over concreting as it cools into a colourless unctuous mass. As it distils, however, the boiling point of the residue rises very considerably, and it becomes darker coloured. Boiled in a retort with water, it is also volatilized in small quantity, and floats like wax on the water which collects in the receiver. Heated over a lamp in a platinum spoon, it takes fire, and burns with a pale blue, surmounted by a white flame, having little smoke, and leaving no residue.

It undergoes no apparent change when boiled in concentrated nitric, muriatic or sulphuric acid. Alcohol, even absolute and boiling, dissolves it very sparingly. The solution is rendered milky by water; and by spontaneous evaporation, deposits the dissolved portion in white flocks. Ether, in the cold, dissolves about four fifths of the whole, giving a solution which, like the substance itself, is brown by transmitted light, and by reflected light exhibits the greenish opalescence, observable in the ozocerite of Moldavia. The solution, by spontaneous evaporation, deposits the dissolved portion in brown flocks, which, at 102° Fahr., melt into a yellow brown liquid. The mass, on cooling, presents the external characters of the original substance, but has less consistence and density. Its specific gravity is 0.885, and it melts at 102° Fahr. A further small portion of the brown undissolved matter is taken up by boiling ether and alcohol. Obtained by evap.

* It is found, according to Dr. Meyer, at the foot of the Carpathians near Slanik, beneath a bed of bituminous slate clay, in masses sometimes from 80 to 100 pounds weight. Not far from the locality are several layers of brown amber. It is associated with the gres bigarré, with rock salt, and with beds of coal.

oration from these solutions, this second portion is colourless, or of a pale yellow; has the appearance and consistency of wax, and melts at 136° Fahr.,—about 16 degrees lower than the fusing point of bees'-wax. The remaining portion, which is almost insoluble in boiling alcohol and ether, has a dark brown colour, and the consistence of soft wax; its density is 0.965; it melts at 163° Fahr., and boils at a temperature above 500° Fahr. The vapour has a peculiar and slightly bituminous odour. It constitutes about one-sixth of the mineral mass.

As it occurs in nature, therefore, this substance contains at least three several compounds, agreeing in their difference to acids, but differing in physical properties and in their relations, especially to ether. The following table exhibits a comparative view of the properties of the mixed mineral—of its three constituent parts—of the specimens of fossil wax from Moldavia, examined by Schrotter and Malaguti—and of the substance obtained from it by the latter on distillation.

	How obtained, or where.	Colour.	Consistence.	Density.
I. Ozocerite (Schrotter).	Found native in Moldavia.	Brown.	Hard, brittle.	0.953 at 15° C.
II. Ditto A. (Malaguti).	Ditto.	Ditto.	Ditto.	0.946 at 20.50.
B.	By distilling A.	0.	Of wax.	0.904 at 17° C.
III. Do. from Urpeth. A.	Urpeth Colliery.	Brown.	Of tallow.	
B.	From A. by cold ether.	Ditto.	Ditto.	0.885
C.	From residue, by boiling ether.	Yellow.	Of soft wax.	?
D.	Residue after boiling A in ether.	Dark brown.	Of wax.	0.955

The fossil wax examined by Magnus, seems to have been identical with that of Malaguti, only it melted at 82° C.

The inspection of this table shows that these mineral products contain at least four substances, possessed of different properties, chemical and physical, of which three are present in that from Urpeth Colliery.

1. One charged by sulphuric acid and insoluble in ether.—(*II. Malaguti.*)
2. One soluble in cold ether.—(*I. and II. B.*)
3. One soluble in boiling ether, and sparingly in boiling alcohol.—(*II. B. III. C.*)
4. A residual portion of greater density scarcely acted on by either of these menstrua.—(*III. D.*)

The different substances composing the ozocerite appear, as I have already stated, to be identical in chemical constitution, being entirely composed of carbon and hydrogen, in the same proportions as in olefiant gas. That the substance from Urpeth Colliery contains no oxygen, is proved by its not affecting the lustre of potassium, when melted along with it. The carbon and hydrogen were ascertained by burning with oxide of copper.

1. 8.43 grs. of the crude mass, freed by fusion from adhering earthy matter, gave 10.69 grs. of water, or 1.187 grs. of hydrogen.
2. 5.47 grs. of the matter taken up by ether, gave 6.92 grs. of water or 0.77 grs. of hydrogen.

3. 5.84 grs. of the same gave 7.39 grs. of water and 18.32 grs. of carbonic acid.
4. 5.47 grs. of the same gave 6.72 grs. of water and 16.58 grs. of carbonic acid.

Melts at	Boils at	In Ether.	Action of hot sulphuric acid.
62° C.=141.6° F.	210° C.=410° F.	Dissolves.	?
84° C.=182° F.	300° C.=572° F.	Almost insoluble.	Chars a portion of it.
56° to 57° C. = 133° to 134° F.	300° C.=572° F.	In boiling ether, very soluble.	?
60° C.=140° F.	121° C.=250° F.	Largely soluble.	0
39° C.=102° F.	?	Wholly soluble.	0
58° C.=136° F.	?	Soluble in boiling ether.	0
73° C.=163° F.	Above 260° C. =500° F.	Very sparingly soluble in boiling ether.	0

These results give for the crude mixed mineral, and for the portion soluble in ether, the same composition.

	1.	2.	3.	4.
Hydrogen,	14.09	14.07	14.06	13.649
Carbon,	85 81	85.83	86.80	83.812
	100	100	100.86	97.461

The ratio of the elements of the fourth analysis is that of atom to atom; the loss I attribute to the pumping out of a portion of the substance from the tube along with the moisture contained in the oxide of copper, the sand with which the tube was warmed in this experiment having been too hot for a substance boiling so low as 250° Fah.

The small portion of matter at my disposal prevented me from subjecting to analysis either of the other compounds contained in the crude mass; the composition of this mass, however, as exhibited in No. I, shows that these also must contain the elements in the same proportion as the matter actually analysed.

The following table shows also the identity, in chemical constitution, of these several substances, with the different varieties of Ozocerite from Moldavia.

	Atoms.	Equivalents.	Per cent. Calculated.	Ozocerite.			
				Magnus.	Schrotter.	Malaguti.	Fm. Urpeth.
Hydroge	1	12.479	14.0349	13.15	13.787	13.95	14.06
Carbon,	1	76.437	85.9651	85.75	86.204	86.07	86.80
		88.961	100.	98.86	99.991	100.02	100.86

The elementary composition of these different substances, therefore, is identical, and is the same as that of olefiant gas. The ozocerite found in Urpeth Colliery must have had its origin in the coal strata. Emitted, in the form of vapour, and carried along by the lighter gas (fire damp,) given

off at the same time, it would pass through the trouble, on its way to the surface, and be partly condensed in the cavities, and other cool places it came in contact with. It is highly probable that the other varieties of fossil wax may have been derived from a similar source.

In considering the inflammable and explosive substances existing in coal mines it is usual to limit the attention solely to the permanent gas given off, without adverting to the possibility of other substances of a volatile nature, being also emitted in the state of vapour. The occurrence of this variety of Ozocerite, in Urpeth Colliery, shows us that the light carburetted hydrogen sometimes carries along with it other volatile substances, and there is strong reason for believing that the combustible portion of the atmosphere of our coal mines rarely, if ever, consists wholly of this light gas. To show the Proteus-like character of the compounds of carbon and hydrogen, in the ratio of atom to atom, and how little chemical analysis can avail directly in determining the total absence of these substances, I subjoin a table, exhibiting the characteristic properties of the numerous bodies we are already acquainted with, in which the elements exist in this proportion.

	How obtained, or where.	State at 60 degrees.	Density.	Becomes solid or liquid at	Boils at	Density of gas or vapour.
Sweet oil of wine.	In preparing ether.	Oily liquid.	0.917	Solid at 31° F	536° F.	?
Solid oil of wine.	Ditto.	Prisms.	0.980	Liq. at 230°	500+	?
Solid oil of roses.	In oil of roses.	Crystalline plates.	?	Do. at 95°	536° to572°	?
Paraffine.	From wood, coal, and animal tars.	Ditto.	0.87	1 ° to 111°	?	?
Naptha.	From natural wells, and from coal tar.	Liquid.	0.75 to 0.78	?	176°to 212°	2.833
Methylene.	Exists in wood spirit.	Gas.	0.4903	?	?	0.4903
Olefiant gas.	By heating alcohol with twice its bulk, of sulphuric acid.	Gas.	0.9806	?	?	0.9806
Faradays light liq	By compres'g oil gas.	Ditto.	1.9612	Liq. at 0°	Below 32°	1.9612
Cetene.	Distilling æthel with phosphoric acid.	Oily fluid.	?	?	527°	7.844
Elaene.	Distilling metaoleic and hydrolaic acids.	Ditto.		?	230°	4.488
Oleene.		Ditto.		?	131°	2.875to3.02
Hatchetine.	Found native.	Solid.	0.916	Liq. at 115°	?	?
Ozocerite.	Ditto.	Ditto.	0.885 to 0.955	Liq. from 102° to 182°	250°to 572°	?
Caoutchene.	Distill'g caoutchouc.	Liquid.	0.65 at	Liq. at 14°	58.2	?
Heveéne.	Do. or from caoutchouc by sulp. acid.	Dense do.	0.921 at	?	579°	?

A glance at the second column of this table shows that several of these substances are obtained from the products of the distillation of coal; and though it has not been *demonstrated* that any of them actually exist ready formed in the mass of the coal itself, yet the very low temperature at which some of them are given off lends to this opinion a considerable degree of probability. Richenbach states that bituminous coal by distillation with water, yields 1.320,000th of an æthereal oil, which is identical with native naphtha; and he concludes that the naphtha and petroleum springs of Persia, India, Italy, and South America, have their origin in the slow distillation of large beds of coal, by the ordinary heat of the earth. The fossil wax of Moldavia and the hatchetine of England, are probably derived from vegetable matter by a like agency.

Naphtha is a comparatively dense fluid, requiring a temperature of upwards of 173° Fahr. to boil it; and, therefore, unless present in large quantity, it will rarely escape from the coal so rapidly as alone to render the atmosphere combustible; but, suppose the very light liquid discovered in oil gas to exist in the coal, it will at once escape as a highly inflammable gas, and materially injure the atmosphere. Because such substances have not hitherto been observed in the air of mines, we ought not hastily to conclude that they do not exist, ready formed, in the great laboratory of nature. The difficulty of detecting them in a limited portion of gaseous matter will, probably, long present insuperable obstacles to the analytical chemist, while the more we learn of the carbo-hydrogens the more likely it appears that several of them should be occasionally present in the air which circulates through mines of bituminous coal.

The common fire damp requires, for its perfect combustion, ten times its bulk, the vapour of Faraday's light liquid thirty times, and that of naphtha forty-five times its bulk of common air. A very small portion of either of the latter, therefore, would render an atmosphere dangerous. The sudden outburst of a small reservoir would pollute a working previously considered safe, and give rise to an explosion where none was considered possible. In a district of country like the north of England, where rich bituminous coal is so abundant, where mines are worked at the very verge of the inflammable state, and where the most serious accidents from explosions occasionally occur, it is of importance, I think, that the probable presence of such substances, in the state of vapour, should be taken into account. Where the coal is richer than usual, and where troubles occur in which these compounds, as at Urpeth, may exist in a liquid or solid state, the rapid escape of combustible matter may be anticipated; while the probability of such escape affords a rational explanation of those sudden and unexpected emissions of gaseous matter which have occasionally been followed by consequences so disastrous.*

An observation familiar to practical men in the English coal fields leads to the same conclusion. In mines where candles or open lamps are used, it is by the appearance of the flame that the miner judges of the purity of the atmosphere, and the presence of combustible matter. When little inflammable gas is mixed with the air, the flame carries over it a very short pale blue *head*, which increases in length as the quantity of the carbo-hydrogen increases, until the whole atmosphere becomes one explosive mixture.

* Another explanation had previously been given by Mr. Hutton, in following up an idea originally suggested we believe by Dr. Paris; see L. and E. Phil. Mag. vol. ii. p. 303; and Parr's Life of Davy, p. 395. Both are probably true.—Edit.

But in different coal fields, the length of *head*, as it is called, which indicates an approach to the explosive state, is very different. In the Newcastle and Leeds coal fields 1½ inches indicate danger; in S. Wales 4 or 5 in. are not unusual. The colour of the head is also a criterion by which the miner judges; when blue, combustible matter is present, and an explosion is to be feared; if brown and muddy, carbonic acid is suspected, and the danger is less.

Though no *particular* conclusions can be drawn from these observations, yet the general result does force itself upon us, that the various compounds of carbon are at different times present in the atmosphere of coal mines in various quantities; and that sudden explosions may often be caused by the escape from cavities in the coal strata of other compounds than that usually called the fire damp, and to which all the mischief is usually attributed.

Durham, March, 1838.

Note.—I have just seen in the possession of Prof. Graham, of University College, a candle formed of a substance said to be found in considerable quantities in the coal mines near Linlithgow in Scotland. It resembles in every respect the Ozocerite candles of Moldavia. The substance is dull brown, and after fusion almost black, reflected and reddish brown by transmitted light; mass opake but translucent at the edges and in thin layers; is greasy to the touch (like Hatchetine,) easily scratched by the nail, has a conchoidal fracture, and when cold has no perceptible smell.

I may here mention also that the Middletonite described in a former paper, has since been met with in the mass of the coal in the Newcastle coal field. May not this substance be the resin of the trees of the carboniferous æra more or less changed.—April 16.

Lond. & Edin. Philos. Mag.

Electrical Induction.

Dr. Faraday in his last series of "experimental researches in Electricity," (eleventh series) thus expresses his opinion of the actual condition and importance of this department of science.

"The science of electricity is in that state in which every part of it requires experimental investigation; not merely for the discovery of new effects, but, what is just now of far more importance, the development of the means by which the old effects are produced, and the consequent more accurate determination of the first principles of action of this most extraordinary and universal power in nature:—and to those philosophers who pursue the inquiry zealously yet cautiously, combining experiment with analogy, suspicious of their pre-conceived notions, paying more respect to a fact than a theory, not too hasty to generalize, and, above all things, willing at every step to cross-examine their own opinions, both by reasoning and experiment, no branch of knowledge can afford so fine and ready a field for discovery as this. Such is most abundantly shown to be the case by the progress which electricity has made in the last thirty years: Chemistry and Magnetism have successively acknowledged its overruling influence; and it is probable that every effect depending upon the powers of inorganic matter, and perhaps most of those related to vegetable and animal life, will ultimately be found subordinate to it."

The true theory of electrical action appears to be absolutely dependent on a knowledge of the nature of Induction. To this, therefore, he has directed, almost exclusively, his recent experimental researches.

"Amongst the actions of different kinds into which electricity has con-

ventionally been subdivided, there is, I think, none which excels, or even equals in importance that called *Induction*. It is of the most general influence in electrical phenomena, appearing to be concerned in every one of them, and has in reality the character of a first, essential, and fundamental principle. Its comprehension is so important, that I think we cannot proceed much further in the investigation of the laws of electricity without a more thorough understanding of its nature; how otherwise can we hope to comprehend the harmony and even unity of action which doubtless governs electrical excitement by friction, by chemical means, by heat, by magnetic influence, by evaporation, and even by the living being?

In the long-continued course of experimental inquiry in which I have been engaged, this general result has pressed upon me constantly, namely, the necessity of admitting two forces, or two forms, or directions of a force, (516. 517.), combined with the impossibility of separating these two forces (or electricities) from each other, either in the phenomena of statical electricity, or those of the current. In association with this, the impossibility under any circumstances, as yet, of absolutely charging matter of any kind with one or the other electricity, dwelt on my mind, and made me wish and search for a clearer view than any I was acquainted with, of the way in which electrical powers and the particles of matter are related; especially in inductive actions, upon which almost all others appeared to rest.

When I discovered the general fact that electrolytes refused to yield their elements to a current when in the solid state, though they gave them forth freely if in the liquid condition (380. 394. 402.) I thought I saw an opening to the elucidation of inductive action, and the possible subjugation of many dissimilar phenomena to one law. For let the electrolyte be water, a plate of ice being coated with platina foil on its two surfaces, and these coatings connected with any continued source of the two electrical powers, the ice will charge like a Leyden arrangement, presenting a case of common induction, but no current will pass. If the ice be liquefied, the induction will fall to a certain degree, because a current can now pass; but its passing is dependent upon a *peculiar molecular arrangement* of the particles consistent with the transfer of the elements of the electrolyte in opposite directions, the degree of discharge and the quantity of elements evolved being exactly proportioned to each other (377. 783.) Whether the charging of the metallic coating be effected by a powerful electrical machine, a strong and large voltaic battery, or a single pair of plates, makes no difference in the principle, but only in the degree of action (360.) Common induction takes place in each case if the electrolyte be solid, or if fluid, chemical action and decomposition ensue, providing opposite actions do not interfere; and it is of high importance occasionally thus to compare effects in their extreme degrees, for the purpose of enabling us to comprehend the nature of an action in its weak state, which may be only sufficiently evident to us in its stronger condition. As, therefore, in the electrolyte, *induction* appeared to be the *first* step, and *decomposition* the *second* (the power of separating these steps from each other by giving the solid or fluid condition being in our hands); as the induction was the same in its nature as that through air, glass, wax, &c., produced by any of the ordinary means; and as the whole effect in the electrolyte appeared to be an action of the particles thrown into a peculiar or polarized state, I was led to suspect that common induction itself was in all cases an *action of contiguous particles*, and that electrical action at a distance (i. e. ordinary inductive action) never occurred except through the intermediate influence of the intervening matter.

The respect which I entertain towards the names of Epinus, Cavendish, Poisson, and other most eminent men, all of whose theories I believe consider induction as an action at a distance and in straight lines, long indisposed me to the view I have just stated; and though I always watched for opportunities to prove the opposite opinion, and made such experiments occasionally as seemed to bear directly on the point, as, for instance, the examination of electrolytes, solid and fluid, whilst under induction by polarized light (951. 955.), it is only of late, and by degrees, that the extreme generality of the subject has urged me still farther to extend my experiments and publish my view. At present I believe ordinary induction in all cases to be an action of contiguous particles, consisting in a species of polarity, instead of being an action of either particles or masses at sensible distances: and if this be true, the distinction and establishment of such a truth must be of the greatest consequence to our further progress in the investigation of the nature of electric forces. The linked condition of electrical induction with chemical decomposition, of voltaic excitement with chemical action; the transfer of elements in an electrolyte; the original cause of excitement in all cases; the nature and relation of conduction and isulation; of the direct and lateral, or transverse, action constituting electricity and magnetism; with many other things more or less incomprehensible at present, would all be affected by it, and perhaps receive a full explication in their reduction under one general law.

I searched for an unexceptionable test of my view, not merely in the accordance of known facts with it, but in the consequences which would flow from it if true; especially in those which would not be consistent with the theory of action at a distance. Such a consequence seemed to me to present itself in the direction in which inductive action could be exerted. If in straight lines only, though not perhaps decisive, it would be against my view, if in curved lines also, that would be a natural result of the action of contiguous particles, but I think utterly incompatible with action at a distance, as assumed by the received theories, which, according to every fact and analogy we are acquainted with, is always in straight lines.

Again, if induction be an action of contiguous particles, and also the first step in the process of electrolyzation (1164. 949.), there seemed reason to expect some particular relation of it to the different kinds of matter through which it would be exerted, or something equivalent to a specific electric induction for different bodies, which, if it existed, would unequivocally prove the dependence of induction on the particles; and though this, in the theory of Poisson and others, has never been supposed to be the case, I was soon led to doubt the received opinion, and have taken great pains in subjecting this matter to close experimental examination.

Another ever-present question on my mind has been, whether electricity has an actual and independent existence as a fluid, or fluids, or was a mere power of matter, like what we conceive of the attraction of gravitation. If determined either way it would be an enormous advance in our knowledge; and as having the most direct and influential bearing on my notions, I have always sought for experiments which would in any way tend to elucidate that great question. It was in attempts to prove the existence of electricity separate from matter, by giving an independent charge of either positive or negative power to some substance, and the utter failure of all such attempts, whatever substance was used or whatever means of exciting or *evolving* electricity were employed, that first drove me to look upon induction as an action of the particles of matter, each having *both* forces devel-

oped in it in exactly equal amount. It is this circumstance, in connexion with others, which makes me desirous of placing the remarks on absolute charge first, in the order of proof and argument, which I am about to adduce in favour of my view, that electric induction is an action of the contiguous particles of the insulating medium or *di-electric.*

Can matter, either conducting or non-conducting, be charged with one electric force independently of the other, in the least degree, either in a sensible, or a latent state?

The beautiful experiments of Coulomb upon the equality of action of *conductors*, whatever their substance, and the residence of *all* the electricity upon their surfaces,* are sufficient, if properly viewed, to prove that *conductors cannot be bodily charged;* and as yet no means of communicating electricity to a conductor so as to relate its particles to one electricity, and not at the same time to the other in exactly equal amount, has been discovered.

With regard to electrics or non-conductors, the conclusion does not at first seem so clear. They may easily be electrified bodily, either by communication (1247.) or excitement; but being so charged, every case in succession, when examined, came out to be a case of induction, and not of absolute charge. Thus, glass within conductors could easily have parts not in contact with the conductor brought into an excited state; but it was always found that a portion of the inner surface of the conductor was in an opposite and equivalent state, or that another part of the glass itself was in an equally opposite state, an *inductive* charge and not an *absolute* charge having been acquired.

Well purified oil of turpentine, which I find to be an excellent liquid insulator for most purposes, was put into a metallic vessel, and, being insulated, was charged, sometimes by contact of the metal with the electrical machine, and at others by a wire dipping into the fluid within; but whatever the mode of communication, no electricity of one kind was retained by the arrangement, except what appeared on the exterior surface of the metal, that portion being there only by an inductive action through the air around. When the oil of turpentine was confined in glass vessels, there were at first some appearances as if the fluid did not receive an absolute charge of electricity from the charging wire, but these were quickly reduced to cases of common induction jointly through the fluid, the glass, and the surrounding air.

I carried these experiments on with air to a very great extent. I had a chamber built, being a cube of twelve feet in the side. A slight cubical wooden frame was constructed, and copper wire passed along and across it in various directions, so as to make the sides a large net-work, and then all was covered in with paper, placed in close connexion with the wires, and supplied in every direction with bands of tinfoil, that the whole might be brought into good metallic communication, and rendered a free conductor in every part. This chamber was insulated in the lecture-room of the Royal Institution; a glass tube above six feet in length was passed through its side, leaving about four feet within and two feet on the outside, and through this a wire passed from the large electrical machine (290.) to the air within. By working the machine, the air within this chamber could be brought into what is considered a highly electrified state (being, in fact, the same state as that of the air of a room in which a powerful machine is in operation,)

* Memoires de l'Academie, 1786, pp. 67, 69, 72; 1787, p. 452.

and at the same time the outside of the insulated cube was everywhere strongly charged. But putting the chamber in communication with the perfect discharging train described in a former series (292.), and working the machine so as to bring the air within to its utmost degree of charge, if I quickly cut off the connexion with the machine, and at the same moment, or instantly after, insulated the cube, the air within had not the least power to communicate a further charge to it. If any portion of the air was electrified, as glass or other insulators may be charged (1171.) it was accompanied by a corresponding opposite action *within* the cube, the whole effect being merely a case of induction. Every attempt to charge air bodily and independently with the least portion of either electricity failed.

I put a delicate gold-leaf electrometer within the cube, and then charged the whole by an *outside* communication, very strongly, for some time togegether; but neither during the charge or after the discharge did the electrometer, or the air within, show the least signs of electricity. I charged and discharged the whole arrangement in various ways, but in no case could I obtain the least indication of an absolute charge: or of one by induction in which the electricity of one kind had the smallest superiority in quantity over the other. I went into the cube and lived in it, and using lighted candles, electrometers, and all other tests of electrical states, I could not find the least influence upon them, or indication of anything particular given by them, though all the time the outside of the cube was powerfully charged, and large sparks and brushes were darting off from every part of its outer surface. The conclusion I have come to is, that non-conductors, as well as conductors, have never yet had an absolute and independent charge of one electricity communicated to them, and that to all appearance such a state of matter is impossible.

There is another view of this question which may be taken under the supposition of the existence of an electric fluid, or fluids. It may be impossible to have the one fluid, or state, in a free condition without its producing by induction the other, and yet possible to have cases in which an isolated portion of matter in one condition being uncharged, shall, by a change of state, evolve one electricity or the other; and though such evolved electricity might immediately induce the opposite state in its neighbourhood, yet the mere evolution of one electricity without the other in the *first instance*, would be a very important fact in the theory which assumes a fluid or fluids; these theories, as I understand them, not assigning the slightest reason why such an effect should not occur.

But on searching for such cases I cannot find one. Evolution by friction, as is well known, gives both powers in equal proportion. So does evolution by chemical action, notwithstanding the great diversity of bodies which may be employed, and the enormous quantity of electricity which can in this manner be evolved (371. 376. 861. 868.) The more promising cases of change of state, whether by evaporation, fusion, or the reverse processes, still give both forms of the power in *equal* proportion; and the cases of splitting of mica and other crystals, the breaking of sulphur, &c. &c., are subject to the same limitation.

As far as experiment has proceeded, it appears, therefore, impossible either to evolve, or make disappear, one electric force without equal and corresponding change in the other. It is also equally impossible experimentally to charge a portion of matter with one electric force independently of the other. Charge always implies *induction*, for it can in no instance be effected without; and also the presence of the *two* forms of power, equally

at the moment of development and afterwards. There is no *absolute* charge of matter with one fluid; no latency of a single electricity. This, though a negative result, is an exceedingly important one, being probably the consequence of a natural impossibility, which will become clear to us when we understand the true condition and theory of the electric power.

The preceding considerations already point to the following conclusions: bodies cannot be charged absolutely, but only relatively, and by a principle which is the same with that of *induction*. All *charge* is sustained by induction. All phenomena of *intensity* include the principle of induction. All *excitation* is dependent on, or directly related to, induction. All *currents* involve previous intensity and therefore previous induction. INDUCTION appears to be the essential function both in the first development, and the consequent phenomena, of electricity.

The electrometer and inductive apparatus employed will be found described in the (R. S.) Philosophical Transactions for 1838, part I, and in the Lond. & Ed. Phil. Mag. for October, 1838.

Meteorology.—Meeting of the British Association.

Dr. Daubeny read a paper "On the Climate of North America."

The Doctor began by observing, that although the general fact was admitted that the eastern portion of the New World possessed a lower temperature than the western portion of the Old, yet that much remains to be done before the relative climate of these two portions of the globe can be regarded as in any degree determined. In proof of this, he exhibited a table, in which he had entered a series of all the mean temperatures of different places in North America, which he had been able from various sources to collect, and showed that the greater part of them were very little to be relied upon as to accuracy. In Canada, the best observations yet made were those by McCord, of Montreal; and, in the United States, those communicated by the Regents of the University of the State of New York, with respect to the mean temperature of no less than thirty-three places within the state, where academies supported at the public expense are established. But the observations are likewise defective, in not taking any account of the intensity of solar radiation, which probably affects the distribution of plants and animals in a manner which is quite distinct from its accompanying temperature. Hence, though many plants which grow in this country are killed by the winters of comparatively southern latitudes in America; yet others, which require the warmth of a wall or of a southern aspect here, are found in comparatively high latitudes in the New World. But though the observations yet made are so imperfect, there seems no want of disposition either in Canada or in the United States to contribute to the advancement of meteorology, and to adopt the suggestions of European philosophers on this subject, as is evidenced by the promptitude with which Sir John Herschel's suggestions, with respect to hourly observations on certain days, have been acted on in both countries; and, hence, Dr. Daubeny suggested that it would be likely to contribute much to the advancement of this science, if the Association were to circulate extensively in the United States instructions both as to the use of meteorological instruments, and as to the proper hours for observing; and if they were to present to three or four public institutions

in Upper and Lower Canada sets of the instruments deemed most important, carefully compared with each other, or with a uniform standard.

Sir John Herschel said, that of all the sciences which now engross the attention of the thinking part of mankind, none required a greater union of exertion than meteorology; in fact, from want of attention to this, there was no science in the pursuit of which so much time and labour had been thrown away. In it, union might emphatically be said to be strength, while mere individual exertion was little better than inaction. With this conviction, he had some time since ventured to propose that meteorological observations, continued through the twenty-four hours, should be made simultaneously in all parts of the globe. He was happy to say, that, in conformity with this suggestion, he had received numerous communications, giving the observations made at widely distant stations on the appointed days; and to none had he to express his obligations in stronger terms than to the philosophers of the United States of America. In some, however, of the most valuable meteorological registers, he found the hours of observation selected were those only of the day. Now, he was aware of the great additional labour required for night observations, and that nothing but zeal of a high-philosopher-power could enable observers, for any length of time, to pursue such observations; but when he considered the importance of these registers to the science, he could not but press the practice anxiously on public attention. The results of these night observations would be found to differ very widely, and often most materially, from those of day; the fluctuations of the barometer were different, the formation and dispersion of clouds and the falling of rain, all followed different laws by night from those which by day controlled their courses.—Sir David Brewster called attention to the important fact, clearly established by the meteorological observations recorded in the neighbourhood of New York, and those of Hansteen and Erman in Siberia, that two points of maximum cold existed in these regions, very generally agreeing in position with the centres of maximum magnetic intensities; and like them, too, the maximum of N. America indicated a decidedly higher degree of cold than that which characterized the Siberian pole. Also, that the lines of equal mean temperature, as they surround these poles, had such a relation to the lines of equal magnetic intensity, as to point out clearly some yet unknown connexion between these two classes of phenomena. The same gentleman who addressed the Section at the close of Mr. Whewell's paper, said, that he could not agree to some of the conclusions at which Dr. Daubeny had arrived. As to the connexion between animal and vegetable life and climate, something more would be found necessary than mere mean temperature. He had often ridden violently and used much bodily exertion in New South Wales, with the thermometer at 110° in the shade, when the same temperature in England would be insupportable; and in the East Indies all Europeans were so enervated when the thermometer stood at this height, as to be nearly incapable of active exertion. As to vegetation, we had on the one side of the Himalayan range, at an elevation of little more than 10,000 feet, lichens, and all the stunted vegetation of the polar regions; while, on the other side, at an elevation of nearly 16,000 feet, we had corn fields and large forest trees, and all the productions of temperate regions of the earth. Nor could he agree in Dr. Daubeny's conclusion, that the mean temperature to the west of the Alleghany mountains was much lower in North America than to the east. In his opinion, the contrary was the fact in many parts west of the Rocky mountains. In California, and along the Columbia river, were found large cedars and other productions of coun-

tries bordering on tropical; while to the east, in the very same latitudes, could only be found lichens, and almost all other polar vegetables. In his opinion, the courses of rivers and of extensive forests, as well as the high ranges of mountainous tracts, were to be taken into account, as influencing, most materially the climate of the circumjacent territories. Dr. Daubeny explained that he had been misunderstood, if supposed to say that all places to the west of the Alleghany mountains were colder in their climate than those to the east, his observations had reference to the space included between the Alleghany and the Rocky ranges of mountains, or what is in part called the valley of the Mississippi, compared with the more eastwardly portion of North America. With many of the other observations of the gentleman he concurred, nor was he aware that they were opposed to any of the statements comprised in his very brief notice of the climate of North America. Prof. Bache, of Philadelphia, made some remarks on the importance of connecting the observations making in the United States, with any which the British Association might institute in the colonies of Britain in North America. Considerable progress, he said, had, within a few years, been made in America in the science of meteorology. The abstracts of the reports of meteorological observations from the academies of the state of New York, and the deductions made from them by Sir David Brewster, had been a great stimulus to increased activity in that department. The recommendations of Sir John Herschel had not only been adopted by individuals, but had led to the formation of societies for the cultivation of meteorology. These, independently of other facts, convinced him that he hazarded nothing in promising the hearty concurrence of meteorologists in the United States in any extensive plan which the British Association should sanction.

Brit. Assoc.—Athenæum.

On Professor Ehrenberg and Hausmann's *Discoveries regarding two varieties of Siliceous Earth found near Oberohe in the Hanoverain Province of Lüneberg.*

On the 8th January 1838, Professor Hausmann communicated to the Royal Society of Sciences of Göttingen, a preliminary notice, on a discovery connected with our own country, which is undoubtedly among the most remarkable facts lately added to the science of geognosy.

In the month of November this year, Colonel von Hammerstein, President of the Provincial Agricultural Society at Uelzen, in the territory of Lüneberg, the able author of several prize essays, and the zealous promoter of the agriculture of his native country, had the goodness to send to Professor Hausmann two specimens of varieties of earth, which were dug out near Oberohe during an excavation made by the abovementioned society in the district of Ebstorf. The extreme lightness of these varieties of earth rendered it improbable that they were of an argillaceous nature; but their state of aggregation did not permit us to conclude that they consisted of pure silica, although, notwithstanding this, they really have such a composition, according to the chemical examination kindly instituted by Dr. Wigners in the academical laboratory. The specimen No. 1, according to this investigation, is chemically *pure silica.* It has, at the same time, a fine, extremely loose, earthy, flaky consistence, and a chalk white colour. It has a soft and meagre feeling, somewhat like starch, and does not grate between the teeth. On water

it swims for a moment, then sinks down, and gradually swells up. Mixed with a little water, it acquires a pasty consistence, without being adhesive. The specimen No. 2. is also silica, but contains likewise a very insignificant quantity of a matter destructible by fire. Its fracture is fine-earthy; the colour brownish-grey, slightly inclining to green, becoming darker by the addition of moisture. It is friable, meagre, but soft to the touch, and adheres to the tongue. It swims on water for some minutes, but it afterwards sinks, absorbing water with a noise, giving out many air-bubbles, and then expands gradually by irregular splitting of the laminæ, without being altogether separated. When exposed to heat, it rapidly assumed a white colour. Here and there it is traversed by veins of pure, chalk-white, fine-earthy, silica, filled with smaller or larger cavities.

According to the information communicated by Colonel von Hammerstein to Professor Hausmann, this silica has been found in astonishing quantity in six different places of the above-mentioned district, on the edge and first acclivity of the great plateau of the *Lüneburger Haide*, covered to the depth of only one foot and a half by the soil. The pure white silica forms the upper bed, and has a thickness of 10 feet to 18 feet. The coloured portion is beneath, and has been already penetrated to a depth of 10 feet, without the lower boundary having been reached.

The peculiar state of aggregation of this silica led Professor Hausmann to conjecture that it might be analogous to the *Kieselguhr* found in the turf at Franzensbad in Bohemia, and that like that substance, it might be composed of the siliceous shields of infusory animals. A preliminary microscopic examination seemed to confirm this notion. In order to attain certainty on this subject, Professor Hausmann sent specimens to the distinguished investigator of the infusory world, Professor Ehrenberg of Berlin, who, by his extraordinary discoveries regarding the occurrence of fossil infusoria, has opened an entirely new field of the most interesting investigations. He requested that naturalist to examine these specimens of earth more minutely, with a special view to these objects, and he received, through his kindness, the intelligence, that *both earths are entirely composed of beautiful and perfectly preserved infusory coverings;* that these are very various, but still belong only to known species, and to such as are found in a living state in fresh water at the present day. In the earth No. 1 they are free from foreign admixture; but in No. 2 they are mixed with organic slime, and with the pollen of pines. During even his first examination, Professor Ehrenberg succeeded in determining several species of infusoria, whose coverings form this silica, and in ascertaining that there occurs, in the lower bed, a species of infusoria found in the polishing slate of Habichtswald and Hungary; and another peculiar to the *Kieselguhr* of Bohemia; both of which seem to be entirely wanting in the upper bed: but upon these points we shall defer further remarks, in order that we may not anticipate the publication of the completed investigation of Professor Ehrenberg.

That a mass more than twenty feet in thickness should consist almost entirely of the coverings of animals which are invisible to the naked eye and which can only be recognised with the assistance of a high magnifying power, is an extraordinary fact, and one which the mind cannot fully comprehend without some difficulty. The farther we attempt to pursue the subject the more we are astonished. That which occurs in an invisible condition in the fluid element, and which cannot be recognised by the human senses without the assistance of art, becomes, by

immense accumulation and solidification, one of the circle of phenomena which are witnessed by us in the ordinary way; a compact mass is formed, which can be weighed, felt, and seen; and this mass is presented to us in such quantity, that, when regarded only in *one* direction, it surpasses by three times the height of the human figure. Who could venture to calculate the number of infusory animals which would be required to produce even one cubic inch of this mass? And who could venture to determine the number of centuries during which the accumulation of a bed of twenty feet in thickness was taking place? And yet this mass is only the product of yesterday compared with the other more compact siliceous masses for which the infusoria of a destroyed creation afforded materials. But what would have become of that loose, light silica,—which, by its great porosity and its power of absorbing water in quantity, in some measure indicates its origin,—if, instead of being covered by soil one foot and a half in thickness, it had been covered by a great mass of earth or rock; or if another power, such as the action of fire, had caused its solidification? In that case, we should have had no bed twenty feet in thickness, but should perhaps have found a compact stony mass, capable of scratching glass, affording sparks with steel, and polishable,—a substance, which, were it not for the abundant evidence furnished by the discoveries of Ehrenberg, it would be still more difficult to suppose had resulted from the coverings of invisible animals. Such a consolidation and hardening of this loose silica, might perhaps be partly accomplished in another way, by making the experiment of employing it for the manufacture of glass, or as one of the ingredients in porcelain; by which means a discovery so very remarkable in a natural historical point of view might at the same time become of practical importance. *Glass formed from the coverings of infusory animals!* Who would a few years ago have believed in the possibility of this substance, by whose assistance invisible life in water is revealed to us, being prepared from a material derived from the same world of extremely minute animated beings; or that we should be enabled, by means of a substance furnished by an invisible creature, to investigate the smallest and most obscure, as well as the largest and most remote, bodies in creation?—(Communicated to us by Professor Hausmann from the "*Göttingische gelehrte anzeigen*," 25th January, 1838.) Ed. Philos. Journal.

An additional interest is given to the foregoing statement by the fact that a deposit of these infusorial coverings, analogous to that above described, has been discovered by Professor J. W. Bailey of West Point, N. Y.; and they doubtless will be found in no inconsiderable extent in other parts of this country. Professor Bailey says the deposit he discovered is "8 or 10 inches thick and probably several hundred yards in extent, which is wholly made up of the siliceous shells of the Bacillaria, &c., in a fossil state;" v. his paper with figured descriptions in Silliman's Journal, October, 1838. We have examined a portion of this "clay coloured mass" from West Point, under the microscope, and witnessed the organic forms as described by the discoverer. G.

Relations of Light Heat, and Electricity.—By M. Becquerel.

If we inquire concerning the relations which exist between the production of heat and the production of electricity, in the mutual friction

of two bodies, the following are the consequences which result from the experiments which have been recently made. The displacement of parts of the rubbed surfaces always occasions a disengagement of heat and a disengagement of electricity,—two effects which exert a mutual dependence. This dependence, however, is so much obscured, that it is still impossible to affirm if the one precedes the other, or *vice versa*. We can only make conjectures on this point,—conjectures which go to shew that the heat is derived from the electricity, when the bodies are of the same nature,—are bad conductors of caloric,—and only differ as to the condition of their surfaces. The surface which is most heated becomes negatively electrified; and that which is least heated positively. When the bodies are different, the effects become more complex, and can be interpreted only when the results are immediately under observation.

Some facts recently brought under review permit us to group together the relations discovered between heat and electricity, and of which phosphorescence supplies an example. It is known that this phenomenon shews itself wherever particles of bodies which are bad conductors of electricity are disturbed by percussion, friction, heat, light, a shock of electricity, or when they are decomposed by chemical action. These causes are precisely those which likewise disengage electricity; and the phenomena being atomic, must produce an infinite number of minute sparks, which together produce a faint light similar to phosphorescence. Hence we may suppose that phosphorescence has an electrical origin.

In glow-worms *(Lampyris)* and the infusoria, we are ignorant whence the phosphorescence proceeds, and whether it be owing to electricity. The important experiments, however, of M. Ehrenberg are about to instruct us. This able physiologist has lately been studying with peculiar care the light which is emitted in darkness by the infusoria and the annelides which make the ocean luminous in certain countries, especially when its surface is agitated by a gentle breeze. Having placed on the object-glass of his microscope, water containing these animalcula, he was exceedingly astonished to perceive, that the diffused glimmer which surrounded them was nothing else than a collection of a vast number of small sparks which came from every part of their bodies, and particularly from the bodies of the annelides. These sparks, which succeeded each other with great rapidity, had such a resemblance with those we observe in common electrical discharges, that M. Ehrenberg does not hesitate to conclude that they are identical. He has also satisfied himself that the light emitted is not owing to a particular secretion, but solely to a voluntary act of the animalcule, and that it shews itself as often as it is irritated by mechanical or chemical means, that is to say, by agitating the water, or throwing either alcohol or acid into it. This is an additional analogy with the torpedo, which only gives a discharge when irritated. In the animalcula, as in the torpedo, it is also observed that the discharge recommences after a certain time of repose. From this similarity of effects, in the same circumstances, may we not infer an identity as to the causes? Now, in the torpedo, it is already known, and no one longer doubts it is electricity; and, hence, we must admit that electricity is also the cause which produces the phosphorescence of the infusoria and the annelides. It is sufficiently remarkable that the luminous or other phenomena which depend upon electricity are so much the stronger in proportion as the animals are smaller; and it would appear that this profusion of the electrical fluid, which is emitted only by

beings of an inferior order, is destined to discharge other functions in beings of a higher order.

Is it not, after this, allowable to imagine, as M. Berzelius and other philosophers have advanced, that the light which is disengaged by combustion, and which occasions so great a disengagement of electricity, is, also, nothing more than the result of the discharge of an infinite number of small sparks produced in the combination of combustible with other burning bodies?

We perceive, therefore, that the relations which associate together light, heat, and electricity, acquire from day to day additional extension, and demonstrate that these three agents which rule in the atomic constitution of bodies, are derived, according to all appearances, from a single principle of an ethereal nature, spread throughout space and through all bodies. Ed. Philos. Journal.

Mechanics' Register.

List of American Patents which issued in February, 1838.
With Remarks and Exemplifications by the Editor.

43. For an improvement in *Propelling Steam Vessels;* John Ericsson, a subject of the kingdom of Sweden, now residing in Great Britain, February 1.

"This invention consists of two broad, metallic hoops, or short cylinders, supported by spiral arms, or spokes, and made to revolve in contrary directions, but at different velocities from each other, round a common centre; such hoops, or cylinders, being also placed entirely under the water at the stern of the boat, and furnished each with a short spiral plate; the plates of each series standing in at an angle the exact converse of the angle given to those in the other series, and kept revolving by the power of a steam engine, whereby a steam-boat may be propelled effectually, notwithstanding any variation in the draught of water."

Such is the announcement of the nature of the invention; after describing which, by references to drawings, the patentee says, "Now, whereas the use of spiral wheels acting obliquely against the water, and moving in contrary directions for propelling steam-boats is not new, I do not claim as my invention the use of such spiral planes, or their contrary motion; but I claim as my invention the metallic hoops, or cylinders, and the spiral arms, or spokes, hereinbefore described, together with the entire immersion of the propeller, by which means I am enabled to employ all the spiral plates at one time, and thereby the beneficial result of a great propelling force will be obtained by a propeller of much less dimensions than heretofore. And, I also claim as my invention, the giving a greater speed to the outer series of spiral plates, which move in the current produced by the motion of the other series, and by which greater speed the beneficial result of saving of power, and increased propelling force will be obtained.

"And I further claim as my invention, the application of the propeller, as described in drawing No. 2, that is to say, *First.* I claim the upright hollow

stern, with its arms, or hollow branches for carrying the propeller, by means of which stern the propeller may be either suspended, and immersed under the water when required to be used, or, on other occasions, lifted out of the water, so as not to interfere with the sailing of the vessel. *Secondly.* I claim the drum, or conical casing for protecting the bevil wheels, and for diminishing the resistance in passing through the water. *Thirdly.* I claim the attaching the propeller to, or detaching it from, the engine, or other power employed on board the vessel, by means of a coupling box at the upper end of the upright shaft of the bevil wheels."

The foregoing will afford a good general idea of the nature of the thing patented; its actual utility is, of course, to be decided by experience; the accounts of its trial abroad, so far as they have been carried, have been satisfactory; this, however, proves but little, as the same might be said of numerous inventions of which we never hear again; appearances, nevertheless, are certainly in its favour. It may be doubted whether the claim made to "the entire immersion of the propeller," can be sustained; spiral wheels, and segments, and also some revolving paddles, have been entirely immersed; but if this claim be considered as limited to the entire immersion of the wheels attached as described, the objection might be removed.

Wheels of this kind, entirely submerged, were probably first essayed in this country. The late Col. Stevens of Hoboken, New York, in the year 1805, informed the writer that he had tried such wheels in the stern of a boat, first using a single wheel in the centre. The tendency of the boat so tried, was to move in a circle; a result due to the lessened resistance, as the vanes rose towards the surface, in consequence of the greater ease with which the water was removed out of the way. Subsequently, two such wheels were tried, side by side, revolving in reversed directions; but the effect not being deemed equal to that which had been hoped for, the thing was abandoned. In the present instance, the shaft of one wheel is a tube, through which that of the other wheel passes, one of the two wheels, therefore, revolving immediately in front of the other; an arrangement which appears likely to be productive of much advantage.

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44. For an improvement in *Pumps;* Joseph Smart, Easton, Northampton county, Pennsylvania, February 3.

This is a double-acting, forcing pump, in which the improvement claimed consists in the inserting of the lower valves in such a manner as that they may be readily removed for repair, without disturbing the other parts of the pump, and without the necessity of working down in the well. One of the lower valve seats is covered with a cap, which may be removed to get at the valve; the other lower valve seat is immediately under the main cylinder, and we do not see in what way this is to be come at more handily than in many other pumps; the claim, however, is confined to the one with the cap.

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45. For an improvement in the *Saw for sawing Ice;* John Barker, Cambridge, Middlesex county, Massachusetts, February 3.

The claim under this patent is to "the peculiar formation and construction of the teeth of the saw," which is made with a handle fixed in the upper end, in the manner of the ordinary pit saw. The teeth are cut in with their upper and lower sides parallel to each other, and sloping towards the

front edge at an angle of about 45°. The space between two contiguous teeth is then sloped back, about an eighth of an inch, in a straight line, which regulates the depth of the cut of each tooth. The front edge is to be thickened, so as to cause the saw to run freely.

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46. For an improved Mill for *Breaking and crumbling lumps of Sugar;* William Bent, city of Philadelphia, February 3.

The sugar is to be put into a hopper beneath which there is a cylinder set round with a number of rows of iron teeth, which cylinder is to be turned by a winch, and the teeth thereon are to pass through slats, or openings, in an iron plate; as the sugar descends, it is operated upon in its passage between the cylinder and plate, and thus pulverized. The claim is to the "reducing of sugar by means of the aforesaid teeth, crushing it against the grating; whereas in the method heretofore used the machine for said purpose consists of two cylinders, of wood, or iron, set in frame work, and nearly in contact with each other, between which cylinders the sugar is passed by turning them with a crank, at great cost of labour."

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47. For an improved process of *Bating Hides and Skins;* Wm. Zollickoffer, Middlebury, Carroll County, Maryland, February 3.

(See Specification.)

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48. For improvements in the *Arrangement of Gearing for driving Machinery;* Jesse Urmy, Wilmington, Delaware, February 3.

The claim is to "the arrangement of an open mortise wheel for turning the two pinions placed inside of the same, in one direction, both acting on the centre pinion on the centre shaft, by means of the cog wheels on the pinion shafts, as described." The machine represented is that called a horse power. The "mortise wheel" is merely a wheel within the periphery of which two pinions revolve, on opposite points, for the purpose of equalizing the bearing of the main vertical shaft, on which the sweep is affixed. This, and a similar provision for equalizing the bearings, constitute the difference between this and some other horse powers.

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49. For an improvement in the method of *Constructing the Screw Arms of all kinds of planes regulated by Screw Arms;* Emanuel W. Carpenter, Lancaster, county of Lancaster, Pennsylvania, February 6.

Ploughs, fillisters, match planes, and others regulated by screw arms and nuts, are the subjects of this patent. The particular difference between this and similar instruments cannot be made known without a much longer description than the matter seems to merit. The claim is to the method as described in the specification. A plough has been deposited in the office as a model, exhibiting good workmanship on the part of the patentee.

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50. For an improvement in the *Power Loom;* Elijah Fairman, Stafford, Tolland county, Connecticut, February 6.

This is a kind of contrivance not to be made known in words alone, and

we can afford no other information therefore, than that general one which the claim will supply.

Claim.—"I claim the improvement of the application of an additional cam and a set of treadles; one cam operating on the harness in the usual manner, by moving it in one direction; my improvement of adding another set of treadles is for moving it in another situation, and for confining the harness by cords from the treadles, attached to both the upper and under side of the harness, instead of the upper side only, in the usual method. I also claim as my improvement the application of the additional cam to the long upright double treadles, and also the additional cords extending from the bottom or lower ends of said long treadles, to the under side of each harness."

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51. For improvements in the machine for *Making and twisting Strands in the process for making Rope;* Moses Day, Roxbury, Norfolk county, Massachusetts, February 7.

This patent is obtained for an improvement on a machine patented by the same person on the 2d day of June, 1836, of which we have not yet given an account, the records having been destroyed prior to our examination of that date. In the machine now patented, the apparatus is so arranged that the strands may be twisted, and the rope wound upon a bobbin, in an apartment no larger than is necessary to contain the machine. The flyer, containing the bobbin, revolves horizontally in a frame of wood, upon two centres which are hollow tubes. The strands pass from a bobbin frame opposite to one end of the machine, through a gauge plate, and thence through the hollow tube upon which that end of the flyer rests, and are twisted on their passage by the revolution of the flyer. On the end of the tube within the flyer, there is a bevil wheel, which gears into a bevil wheel on a shaft which crosses the flyer, and has its gudgeons in its two opposite sides. The rope passes two or three times round the shaft of this wheel, and thence to two guide pullies on one side of the shaft, which conduct it on to the bobbin.

The bobbin is placed upon a sliding shaft which passes through the tube that forms the back centre of the flyer, there being a suitable apparatus for giving it the reverse motion necessary to the winding of the rope, and the bobbin having the requisite friction on the shaft to cause the rope to be wound correctly. The claim made is to "the combination of the gauge plate with the flyer, constructed and operating substantially as described."

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52. For a *Remedy for Salt Rheum, &c.;* William B. Trufant, Bath, Lincoln county, Maine, February 10.

Since the new organization of the Patent Office the number of patents for medicines has been much diminished, as it is now considered to be the duty of the office to reject all applications where the composition proposed to be patented, is substantially the same with those known in the regular practice, or where the compound is of a kind which would render it one of special danger, if placed at the disposal of those who are unacquainted with its nature; and through this ordeal there are but few of the proposed remedies that can pass, and live. The demand of *novelty*, is one which the law makes in every case; this, therefore, is the ground upon which the first rule rests. The law

also requires *utility*, and although applications are not rejected because the utility is not apparent, as this might lead to unjust decisions, founded upon a mere matter of opinion, yet it has been decided in court, that the term useful is to be taken as contradistinguished from hurtful, or injurious, and that a man cannot, therefore, have a patent that would poison people, or would be otherwise injurious to the community; this, therefore, is the ground of the second rule, the propriety of which must be perfectly obvious, except by him to whom a patent is refused. The law is for "the promotion of the useful arts;" and that which does mischief cannot well come under this category.

It will be seen that notwithstanding all the care that the office can exercise, some despicable and worthless things must obtain the sanction of its seal, and it is believed that the medicines patented will be pre-eminently of this description; of this the public will have an opportunity of judging, as they will all be published, at full length, in this journal. The specification of the patent which has given rise to the foregoing remarks, will be found in the present number.

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53. For improvements in the machine for *Spreading lime, marl, and ashes on land, and exchanging soils*; Daniel T. Hill, Plainfield, Essex county, New Jersey, February 10.

This machine consists, mainly, of two cylinders, each formed of slats running longitudinally from one head of the cylinders to the other; these cylinders pass into each other, the inner being of a size to slide freely within the outer one; the number of slats in each is equal, and they have space between them about equal to the width of the slats. The outer cylinder may be turned upon the inner, and the spaces between the respective slats will thus be perfectly regulated. An axle passes through the inner cylinder, and has a wheel on each end, similar to a cart wheel, the axle running in bearings on a frame to which the horse is to be attached. There are openings for the purpose of admitting the manure, or other article, to be spread over the ground, and the operation of the whole must be perfectly apparent. The claim is to "the combination of two cylinders of slats, or rounds, and the mode of connecting them with the wheels, in the manner above described."

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54. For a mode of *Preserving Grass for Hay, &c.;* A. D. Ditmars, Chester county, Pennsylvania, February 15.

This patent is taken for forming air-tight bins, or boxes, in barns, &c., which are to be lined with sheet lead. The grass when cut, in dry weather, and free from dew, is to be placed in these receptacles, the lids fastened down, and the whole kept close until wanted in winter, when they are to be opened, and the grass used as feed. The claim is to "the preservation of grass for hay, by excluding it from the air in sheet lead, in the manner set forth."

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55. For an improvement in the *Straw Cutter;* Jonathan S. Eastman, city of Baltimore, February 15.

In this machine the straw is to be fed from a trough made in the usual manner, and the cutting is to be effected by means of a revolving knife, or knives, extending between two circular heads, the axis of which crosses the mouth of the trough. The claims made are to a particular mode of attach-

ing and detaching the hinder part of the box, for convenience of packing; to a double eccentric feeding apparatus, as combined with the other parts; and to an iron frame, described in the specification. These peculiarities, on which the claims rest, do not present any thing which changes the general character of the apparatus, or which requires particular notice. They are intended as improvements upon a machine of the same general character, for which a patent was obtained in the year 1822, and which is now, of course, public property.

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56. For an improvement in the *Machine for making Bricks*; J. Reeder, Cincinnati, Ohio, February 15.

A permanent, circular foundation of stone, or of wood, forty feet in diameter, is to be laid on the ground, and upon this a strong circular frame is to be fixed, on the face of which, and near to its periphery, the moulds are to be placed which are to receive the clay; these moulds are to be of iron, and the clay as it is dug from the bank is to be shoveled into them. A wheel, eight or ten feet in diameter, and weighing about three tons, is made to revolve over the moulds, it being connected by a horizontal shaft, to a vertical shaft rising from the centre of the platform; two or three passages of this wheel, will, it is said, press the brick sufficiently. Followers, raised by treadles, are employed to elevate the brick from the mould. The claim is to "the combination of the circle of moulds, and their appendages, with the wheel, for pressing the clay into the moulds, as above described."

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57. For an inclined *Excavating Box Wheel, for excavating Earth*; James Rowe, Triana, Madison county, Alabama, February 15.

A large wheel, made of iron, is to be mounted on a suitable frame, so as to stand at an angle of about fifty degrees from the perpendicular, [we suppose] the lower edge of this wheel is to rest on the ground, and it has buckets all round its periphery, on its upper surface, which buckets are to receive the earth that is excavated, and to carry it round until it arrives at the full elevation of the wheel, where there is a contrivance for opening the false bottom of the buckets, and allowing the earth to fall through either on to a bank, or into carts, or other vehicles, for its removal; the box wheel revolves on a pivot at its centre, attached to the frame. A wheel of the ordinary kind sustains the other side of the frame of the machine. To the frame is attached a plough, in such a way as that the earth turned up by it shall fall into the buckets of the inclined wheel.

The claims made are, "1st. The above described mode of constructing the revolving box wheel. 2d. The method of opening the shutters of the boxes by the double inclined plane for the discharge of the earth. 3d. The method of adjusting the frame and box wheel, by the crank, arm, and semicircle, together with the combination and arrangement of those parts, substantially in the manner set forth."

The general construction of the apparatus is sufficiently obvious from the drawings and description, but the latter is far from clear in the details. The invention itself, we are very apprehensive, will lend but little aid in the business of excavation.

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58. For an improvement in the construction of *Many chambered Fire Arms;* E. A. Bennett, and F. R. Howland, Waterville, Kennebec county, Maine, February 15.

This many-chambered gun has, we believe, the merit of entire novelty as

regards the manner in which the pieces containing the chambers are combined and arranged. Each chamber is made in a separate rectangular block of metal, of sufficient size for the balls to be used. In the gun which we have seen, there are twelve such blocks; they have hinge joints at their anterior angle, by which they are united so as to form an endless chain of chambered blocks. This chain passes round two cylindrical pieces of metal in the rear of the barrel, by the revolution of which one of the charged chambers is brought into place. The blocks have each a nipple on their upper sides to receive a percussion cap. The claim is to "the construction of an endless chain of chambers, connected together by the hinged joints, arranged and operating substantially in the way herein described."

We have more than once remarked that in the technical vocabulary of patentees, the ordinary meaning of the word improvement is merely alteration, and under this acceptation of the term, the plan before us is a real improvement, although, as we believe, its complexity will render it much less useful than some of its predecessors on the patent list.

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59. For an improvement in the *Plough;* William T. Sprouse, Sangamon, county of Sangamon, Illinois, February, 15.

The improvement claimed is to "the making of the mould and bar out of one single piece of iron, by cutting and bending, instead of making them out of two pieces of iron, and welding them together." The dimensions of the plate and the manner of cutting and bending it, are pointed out in the specification.

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60. For an improvement in the method of making the *Springs for Locomotive Engines, Rail-road Cars, and other Carriages;* Johannes Oberhausser, Charleston, South Carolina, February 15.

The claim under this patent will give a good general idea of what is viewed as constituting the improvements in this spring; it is as follows:

"What I claim as constituting my improvements, is the manner of connecting the leaves of this spring by means of straps passing up between the jogs, or shoulders, and secured by nuts, without the aid of mortises, or notches, and corresponding projections as usually employed. I claim also the mode of forming the centre bearing of this spring, making it a semi-cylinder, which is received into a corresponding cavity in the head of the slide. I likewise claim the dividing it into two or more portions connected and combined at their ends, as set forth."

The last claim refers to the bending the leaves of the springs, towards each end, in such a manner as to leave a space or spaces between them, instead of allowing them to lie upon each other; and afterwards connecting them at their extreme ends by making them clasp round a pin, or stirrup, in the usual manner.

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61. For an improvement in the method of *Fastening Bedsteads;* William Bell, city of Lexington, Kentucky, February 15.

The side, and head, and foot-rails of the bedstead are notched on their sides to admit a short block of wood which crosses from one rail to another diagonally, near to the posts. A single screw passing through the centre of this block into the inner angle of the post, serves to fasten the two rails to each post. The claim is to "the fastening the rails to the posts by means

of a screw and nut on an inner or wooden pin driven diagonally, or through each post, or by a key and mortise as described."

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62. For an improvement in the *Boom Derrick*, for hoisting and laying Stone; James D. Savage, Boston, Massachusetts, February 15.

The mast of this hoisting apparatus has a platform surrounding its lower end, for the workmen to stand upon, and upon this platform is situated a frame with two windlasses, acting independently of each other; the ropes from these windlasses pass round two shieves, in the cap of the mast; one of the ropes passes thence round a shieve, and to a block at the end of the boom, with tackle attached to a Lewis for raising the stone in the ordinary manner. The other rope proceeds directly from the head of the mast to a block attached to the Lewis, and serves to draw the stone in towards the mast. The platform at the bottom of the mast, and the cap at its top, both swivel round, and the stone is therefore completely under command, as it can be raised as required by the usual tackle at the end of the boom, be drawn in to any required extent, by the second tackle, and be readily carried round to any point described. The claim is to "the combination of the whole machinery as above described, for the purpose of hoisting stone or other bodies; and, secondly, the second set of machinery, and rope, or ropes, to act on the stone or other body, and draw it in a direction towards the mast."

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63. For an improvement in *Water Wheels;* John W. Moon, Roxbury, Delaware county, New York, February 15.

This wheel differs but little from some of the before patented modifications of the re-action wheels, a very numerous family, each individual of which undertakes to coax the water by which it is actuated to exert a power equal to that which it can exercise on a well-arranged overshot; hitherto, however, they have manifested no disposition to violate the laws of hydrostatics, and we are very sure that the present effort will not be more successful than those of former applicants for special favour. The water wheel now under consideration is fixed on a vertical shaft, has spiral apertures close by its periphery, open on its lower and upper faces, is placed so as to fit on to, or into a box, or reservoir below it, into which water is to be admitted through a penstock leading down into it; this water is to pass in at the lower end of the spiral ducts, and out at the upper, and by its exit to drive the wheel round. The claim is to "the use of a wheel having spiral apertures into which the water is admitted from a reservoir below, and discharged at the upper side of the wheel; the whole constituted, combined, and operating, substantially as set forth."

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64. For an improvement in the *Regulator for Steam Boilers;* Seth Graham, Roxbury, Norfolk county, Massachusetts, February 15.

This boiler is intended to accomplish the desirable end of indicating and regulating the height of water within it, and, consequently, of obviating one of the main causes of explosions. The means adopted depend upon the action of the old device, a float, but one differently arranged from any which we recollect to have seen described. The float consists of a long, cylindrical tube of metal, closed at its ends, and extending nearly the whole length of the boiler. Through the centre of the boiler passes an iron shaft, which extends out at the front head, its gudgeon there passing through a

stuffing box, and the other end turning in a bearing on the centre of the back head. The float is to be connected to this shaft, by arms, at its ends, of a length nearly equal to the semi-diameter of the boiler, so that the float as it lies on the surface of the water, shall nearly touch its periphery. On to the projecting end of the shaft, at the front head, there is to be affixed a rod crossing it at right angles, and having movable weights affixed to it which may be made to balance the float. Another bar is fixed to the shaft, at the same place, which is called the index arm, and this, as the shaft turns, is to operate on the feed pump, and to regulate its motions. The mode in which it is to do this is not indicated, but is left to the inventive talent of the constructor. A fire flue passes through the boiler, and the flame is to play among circulating tubes. The claim is to "the water regulator constructed and applied to steam boilers in the manner herein described." We see no reason why this float should not be equally good with others upon which the practical engineer places no reliance; nor do we perceive any ground of preference to be given to it. We believe that it still leaves the subject of ascertaining the height, and regulating the supply, of water, open to improvement.

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65. For an improvement in *Fire Arms;* Henry and Charles Daniel, Chester, Middlesex county, Connecticut, February 15.

In this gun the chambers are formed in a revolving mass of metal operating like the cylinder in Cochran's gun, but made polygonal instead of circular, and having a projecting fillet round the mouth of each chamber, to fit into a corresponding recess on the back end of the barrel. As the chambered piece revolves, provision is, of course, made to allow it to recede and advance sufficiently to adapt it to the barrel; this, and other minor points, we shall not take time to describe. The following is the claim:

"We claim the manner in which we have applied such a chamber by fitting it to a recess in the breech, and confining it there by means of the hinged strap, constructed and operating in the manner described."

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66. For an improvement in making *Locomotive Engines and Car-Wheels;* Henry R. Durham, city of New York, February 15.

(See Specification.)

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67. For improvements in the machine for *Tongueing and grooving Boards,* and for working mouldings, &c.; Samuel Shepherd, and Daniel Baldwin, Nashua, Hillsborough county, N. Hampshire, February 21.

In this machine the tongues, grooves, or mouldings, are to be formed by revolving cutters, but the arrangement of the respective parts of the machine, to which the references in the specification are numerous, we shall not attempt to describe, but merely give the claim.

"What we claim as our invention and desire to secure by letters patent, is the construction of the reverse operating, revolving, planing wheels, i. e. the double mouth so as to insert reverse cutters, for the specific purpose of operating with and against the grain of the wood; believing this to be the best adapted mode in use for the purpose of working the various kinds of wood; also, the particular inclining form of the guide and lip, by which the slab is raised perpendicularly above the revolving planing wheel, and kept by the lip from coming in contact with the movements of the machine; also

the particular mode of weighting down the board, or plank, on the carriage as it passes, as specified."

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68. For an improvement in the mode of *Constructing the Flues and other parts of Kitchen Ranges*; Samuel Pierce, city of New York, February 15.

In this kitchen range there is an oven above, and one back of, the fire, similar to ovens in some other ranges. There are compartments for heating, or baking, in the hubs, or jambs, on each side of the range, situated like other such compartments, but differing in the connecting of the two hubs at their rear ends by a flue running immediately back of the fire, and separated from it only by the back lining, through which it consequently receives a high degree of heat. From this latter flue, one extends up into the oven first named, so that there is a free communication of heated air among these respective compartments. Above the fire place there are two escape flues, one for the smoke and gases from the fire, and the other for the steam from the culinary vessels.

Claim.—"What I claim as my invention and wish to secure by letters patent, is the connecting of the compartments in the hubs, by means of the flue running behind the fire. I do not claim the compartments, only as thus combined and connected. I claim also the connecting of these compartments and flue with the oven, in the manner and for the purpose set forth; and I likewise claim the constructing of a flue for steam and vapour, distinct and separate from the smoke flue, upon the principle, and for the purpose, set forth."

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69. For a discovery in the *Manufacture of Brown Paper*, from a new material called Sand Grass; Isaac Sanderson, Milton, Norfolk county, Massachusetts, February 22.

(See Specification.)

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70. For an improvement in the *Machine for washing Rags*, in the manufacture of Paper; Robert Carter, Elkton, Cecil county, Maryland, February 22.

Claim.—"The improvement claimed consists in the arrangement, as described, of the inclined screen of the washing engine of the paper mill, below the axis of the cylinder, instead of above it, so as to separate the foul water from the pulp, by causing the water to descend by its gravity through the inclined screen and pass off through apertures in the side of the cistern into a box constructed on the outside thereof, regulated by a gate, whilst the rags and pulp pass gently down over the screen into the cistern again, and around the partition to the cylinder, to be acted on in like manner, instead of the old method of placing the screen above the axis of the cylinder, and dashing the foul water through it by the motion of the cylinder, which necessarily drives with it a large portion of the pulp, thus causing a great waste of material to the manufacturer."

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71. For an improvement in the *Artificial Horizon*, for Quadrants and Sextants; Charles Goulding, city of Mobile, Alabama, February 24.

A glass tube bent in the form of the letter U, is to contain a coloured liquid. The ends of the tube are to be capped with brass, a tube passing from one cap to the other, to allow a free communication of air. This

apparatus is to be attached to the quadrant, or sextant, in such a manner as that the two ends of the column of liquid shall be in the same plane with the sight, which will be in the centre of the chord of the curve formed by the column of liquid. The claim made is to "the arrangement of the water level with the quadrant or sextant in the manner described, for showing the place of the horizon when it cannot be seen; which will enable navigators to take a correct observation of the sun's altitude, when the sun is clear in the heavens, and the horizon is covered with a thick vapour, and invisible."

We are of opinion that a correct observation cannot be obtained by the means proposed; the capillary attraction alone, we apprehend, would prevent this, even in a vessel considerably larger than any tube that can be employed, attached to the quadrant. The surface of the fluid would never be flat, and its adhesion would render its motion sluggish.

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72. For an improvement in *Operating the Treadles in Power Looms;* Eli Norton, Stafford, Tolland county, Connecticut, February 22.

The claim is to "the arrangement of a single set of wheels with eccentric grooves for vibrating the levers, or treadles, for raising and drawing down the harness of the looms, as described."

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73. For an improved *Spark-arresting Flue for Locomotives*; Johannes Oberhausser, Charleston, South Carolina, February 24.

There are to be two, or more, enlargements of the ordinary flue, constituting drums of about three times its diameter; below each of these drums wire gauze is to be stretched across the flue, and near the bottom of each drum there is to be a partition perforated with three, four, or more, large holes; into which tubes are fitted which rise nearly to the tops of the drums, and are there recurved, so as to cause the sparks to descend and fall on the partitions which sustain the tubes.

The claim is to "the combination of the various parts as described; that is to say, the constructing of two or more drums or chambers, of greater capacity than the flues, with their partitions, recurved flues, and sheets of wire gauze, all constructed, arranged, and combined, as set forth." Which arrangement, construction, and combination, if they serve to arrest the sparks, will, at the same time, serve to arrest the draught also.

Specifications of American Patents.

Specification of a patent for an improvement in the manufacture of Brown Paper, from a new material called Sand Grass. Granted to Isaac Sanderson, *Milton, Norfolk county, Massachusetts, February* 22, 1838.

To all to whom these presents shall come, I, the undersigned, Isaac Sanderson, of Milton, in the county of Norfolk, and commonwealth of Massachusetts, paper-maker, send greeting.

Be it known, that I, the said Sanderson, have discovered and invented a new and useful improvement in the manufacture of Brown Paper, by the use of a new material for that purpose, not in use before, of which the following is intended to be a full and exact description; that is to say, I use

for this purpose a grass which usually grows in the sand upon beaches near the sea-shore, and above the usual high-water mark, commonly called sand grass, or beach grass.

This grass is to be cut down and dried in the usual way. A convenient quantity is then to be taken and put into a vessel, or cistern, and boiled in a solution of lime, or potash, over a fire, or by steam, for about two hours. The solution is to be made by putting about the proportion of a peck and a half of lime, or three pounds of potash, to a hogshead of water. After the grass has been thus boiled, it is to be taken from the vessel, or cistern, and cut into pieces two or three inches in length, in the way and manner in which materials are usually cut for making paper. When so boiled and cut, it is to be put into the engine and beaten; and while the process of beating it is going on, potash dissolved in water, in the proportion of six lbs. of potash to two hundred pounds of this grass, and train oil, or spermaceti oil, in the proportion of about half a pint to the same quantity of the grass is to be put into the engine, so as to mix with the material and the water in the engine. The grass is there to be beaten and prepared in the usual way of preparing materials for making paper.

What I claim as my invention and discovery, is the use of said grass, in, and for, making brown paper. ISAAC SANDERSON.

Specification of a patent for a composition of matter for the cure of Salt Rheum, and other purposes. Granted to WILLIAM B. TRUFANT, *Bath, Lincoln county, Maine, February 10th,* 1838.

Be it known that I, William B. Trufant, of Bath, in the county of Lincoln, and state of Maine, have invented a new composition of matter as a remedy for the Salt Rheum, and other humours of a similar character, consisting of a mixture to be taken internally, and of an ointment to be applied externally, at the same time, of which a full and exact description of the composition, mode of preparing and using, is as follows, viz:

The mixture for inward application is composed of the inner bark of the black cherry, yellow birch, white ash and white poplar, or aspen, trees—and of the black alder and coffee hazel shrubs, or bushes, all ground about as fine as coarsely ground coffee, so as to be convenient for steeping, to be used when dried sufficiently for grinding. Also the leaves and stock of the lignum pinæ plant, dried and pulverized about as fine as the barks, and the wood of the lignum vitæ tree, scraped, or rasped, as fine as common saw-dust; and common blue clay. These may be used in equal quantities, but I prefer less, say one half as much, of each of the last four named articles, as of each of the others. When mixed together, it must be steeped in water, at the rate of one ounce of the mixture to two-thirds of a pint of water; the steeping to be performed by pouring on the water, in a boiling state, and after keeping it on, at nearly boiling heat, for about ten minutes, pouring it off to cool for the use of the liquor. I do not, however, prepare the liquor for sale, inasmuch as it will sour in warm weather, generally in a week; and therefore no more should be steeped in summer than may be used in four or five days, as it is worthless when sour. I intend to offer the mixture for sale, ready for steeping, with directions. The liquor thus to be prepared, is to be taken night and morning until a cure is effected; which will, ordinarily, be from one to three months, according to the nature of the case.

An adult patient may commence with about a wine-glass full for a dose, increasing to double that quantity in two or three days. It should be taken before breakfast, and shortly before going to bed, while the stomach has not much food in it. Children should take in proportion to age and strength, although some excess would not be dangerous; and if the patient be a nursing child, it is better that the person affording the nourishment should take a half dose, while the child may take less in proportion. The liquor may be sweetened with molasses, if preferred by the patient.

The ointment consists of fresh butter, (for which lard may be substituted, if butter cannot conveniently be had) tar, rosin, spirits of turpentine, red precipitate, and a sirop made of about the consistency of thin molasses, from the bruised, or ground root of the lignum pinæ plant; in the proportion of half a pound of butter, half an ounce of the precipitate, two ounces of tar, two ounces of rosin, one gill of spirits of turpentine, and a table spoonful of the sirop. These should be immersed together until, when cool, they form an ointment of about the consistency of butter.

This ointment is to be used by rubbing it with the hand on the parts affected, until the pores of the skin are well filled with it, at night only, after taking the liquid of the mixture inwardly, beginning its use only after having taken the other five or six times, and continuing it until a cure is effected.

When the lignum pinæ plant cannot be obtained, the mixture and ointment are useful without it, although less efficacious.

What I claim as my invention, and desire to secure by letters patent, is the composition of matter, consisting of the mixture, and ointment, containing the several articles aforesaid, to be used as before described, as a remedy for the Salt Rheum, and other similar humours, or complaints.

WILLIAM B. TRUFANT.

Specification of a patent for an improved process of Bating Hides and Skins. Granted to WILLIAM ZOLLICKOFFER, *Middleburg, Carroll county, Maryland, February* 3, 1838.

To all whom it may concern, be it known that I, William Zollickoffer, of Middleburg, in the county of Carroll, and state of Maryland, have invented a new and useful improvement for bating all kinds of Hides and Skins, and I do hereby declare that the following is a full and exact description.

The nature of my invention consists in using the muriate of ammonia as a bate for all kinds of Hides, or Skins, either alone, or in combination with either hens' dung, pigeons' dung, or dogs' dung, with which I bate them in a much shorter time than is required by using either of the three last mentioned substances alone.

To enable others skilled in the art to make and use my invention, I will proceed to describe the manner of using it, and its operation. When I use the muriate of ammonia alone, I take seven pounds, which I reduce to a coarse powder, and upon which I pour ten gallons of hot water, in order to facilitate its solution. This solution I throw into a vat containing a sufficient quantity of clean water to cover five hundred pounds of Hides, or Skins, dry weight, in a state of preparation for the bate. Into the bate I thus prepare, I throw in this quantity of Hides, or Skins; with which I bate all kinds of skins in one hour; horse hides in two hours; and ox hides, and other thick hides in three hours. The ox hides, and all other hides, I hap-

dle once during their continuance in the bate; in an hour after they have been placed into it; and when I use the muriate of ammonia in combination with either hens' dung, pigeons' dung, or dogs' dung, I take two pounds and a half of the muriate of ammonia, which I dissolve in four gallons of hot water, after having previously reduced it to a coarse powder. This solution I throw into a vat containing the necessary quantity of either hens' dung, pigeons' dung, or dogs' dung bate, that is required for bating five hundred pounds of hides, or skins, dry weight. Into the bate I thus prepare, I throw this quantity of hides, or skins, in the usual state of preparation for undergoing the process; taking care, however, previously to place them into a pool of clean water for five minutes, to wash off the dirt and ime. With this process I bate all kinds of skins in three hours, horse nides in six hours, and ox hides, and other thick hides, in nine hours. The ox hides, and other thick hides I handle three times; the end of the second, fourth, and sixth hour after they have been submitted to its operation. Horse hides I handle twice; the end of the second and fourth hours; and all kinds of skins I handle once, the end of the first hour after. The hides and skins which are bated with this process are reduced and softened, and in every way prepared for the bark, analogous to those which are bated with either hens' dung, pigeons' dung, or dogs' dung alone; and the hair, dirt, and lime work out with equal ease. After they are bated with my process, they are to be stoned, or treated over the beam, like all other hides and skins.

What I do claim as my invention, and desire to secure by letters patent, is the application of the muriate of ammonia as a bate for all kinds of hides and skins, either alone, or in combination with either hens' dung, pigeons' dung, or dogs' dung, as herein described, using for that purpose any substances which will produce the intended effect.

WILLIAM ZOLLICKOFFER.

Specification of a patent for an improvement in making Wheels for Locomotive Engines and Rail Road Cars. Granted to HENRY R. DUNHAM, *city of New York, February* 15, 1838.

To all whom it may concern, be it known, that I, the undersigned, Henry R. Dunham, of the city, county, and state of New York, Engineer and Machinist, have invented a new and useful method, or improvement, in making *Locomotive Engine and Rail Road Car wheels*, and I do hereby declare that the following is a full and exact description thereof.

This wheel I cast in an iron mould and is properly called the *Chilled Wheel*, from the fact of being hardened on the entire periphery, caused by coming in contact with the iron mould at the time of casting it; but instead of continuing the arms of the wheel to the rim, as is now the case, and partly annealing that section of the rim to which it extends, I make two rims, the space between them being two inches, the same can be more or less and continue the arms of the wheel no farther than the inner rim, thereby leaving an uninterrupted space under the outer rim of two inches, more or less; which gives to the outer, or chilled, rim, an even tempered, or chilled, surface, (more durable and not liable to flatten opposite the arms, obviating that difficulty in the wheels now in use) the outer rim being connected by the sides, or edges, to the inner rim, to which the arms of the wheel extend. The space between the inside and outside rim is made by

the insertion of cores, supported at intervals by cores, in the usual manner. What I claim as my invention, or improvement, and desire to secure by letters patent, is the making of two rims, connected at the sides, and leaving an uninterrupted space under the outside rim, excepting where it is joined at the edges, or sides of the wheel, and the said vacant, uninterrupted space extending entirely around the circumference of the wheel, between the outer and inner rim; in other words, constituting a hollow felly, cast in one hollow, connected mass, entirely around said wheel; and the whole wheel, it may be further remarked, is cast in an entire casting.

HENRY R. DUNHAM.

English Patents.

Specification of the Patent granted to RICHARD TAPPIN CLARIDGE, *of the County of Middlesex, for a Mastic Cement, or Composition applicable to Paving and Road making, covering Buildings and various purposes to which Cement, Mastic, Lead, Zinc, or Composition are employed.*—Sealed November 25, 1837.

To all to whom these presents shall come, &c.—*Now know ye*, that in compliance with the said proviso, I, the said Richard Tappin Claridge, do hereby declare the nature of the said invention, to consist in a combination by means of heat, of certain substances hereinafter described into a mastic cement or composition applicable to paving and road making, and various purposes to which cement, mastic, lead, zinc, or composition is employed, and one of such substances is a natural compound, consisting principally of carbonate of lime and bitumen, with a small portion of aqueous and other matter, and such natural compound is commonly called or known by the name of asphalte or asphaltos or calcareous asphalte, asphaltic mineral, or asphaltic rock, or asphaltic stone, and such natural compound is hereinafter called asphalte, it is found at Pyrimont, near to Seyssel, in the department De l' Ain, in the kingdom of France, and in other parts of the Jura Mountains, and in other places in great abundance; and the other of such substances is bitumen or mineral or other pitch; and I do hereby describe the manner in which the said invention is to be performed by the following statement. I take the said asphalte in its native state, as it is extracted in masses from the mine, and I greatly prefer, for the purpose of my invention, the asphalte from Pyrimont, aforesaid. The said asphalte from Pyrimont aforesaid, contains, in addition to a small portion of aqueous and other matter, carbonate of lime and bitumen in about the proportion of ninety parts of carbonate of lime to about ten parts of bitumen, and the cement formed accordingly to the said invention, from the said asphalte of Pyrimont, and bitumen, is better than that formed from any other asphalte which I have yet been able to procure, although asphalte is found in other places. And I reduce the asphalte to powder. The asphalte may be reduced to powder solely by mechanical means, but the reduction thereof to powder is facilitated by heat. I usually place the masses of native asphalte in a furnace or oven, the bottom whereof is made of plate-iron; in about half an hour, by the application of a brisk fire, the asphalte falls or is readily

reduced to powder, the asphalte after being exposed to heat, as above mentioned, or otherwise, or reduced to powder, or small parts, by mechanical means, is then passed through a sieve, the meshes of which are about one fourth of an inch square; the asphalte which has passed through such sieve is in a fit state to be mixed with the bitumen or mineral or other pitch; the bitumen or mineral pitch is found in a natural state combined with earthy or other matter in great quantities in the neighbourhood of Pyrimont, and in other places. I have ordinarily used the bitumen found in the neighbourhood of Pyrimont, but the bitumen as found elsewhere may be used without injuring the quality of the cement produced, or other pitch may be used instead of such mineral pitch aforesaid; the bitumen is freed from its extraneous matter in the ordinary way.

In forming the cement or composition according to the said invention, when I use the asphalte of Pyrimont, and the bitumen or mineral pitch also from the neighbourhood of Pyrimont, I take about ninety-three parts of asphalte reduced to powder, and passed through such sieve as aforesaid, to about from seven to ten parts of such bitumen or mineral pitch. The quantity of bitumen intended to be used is first placed in a melting cauldron or furnace, and when it is dissolved the powdered asphalte is added gradually, the mixture is kept carefully stirred in order that it may not be burnt, and also that the asphalte and bitumen may be perfectly amalgamated, the mixture is kept over the fire, carefully stirred, until the whole is thoroughly combined and is nearly fluid. This combination is the mastic cement or composition according to the said invention. The melting cauldron or furnace should be kept over rather a slow fire until the mixture is nearly in a state of ebullition, it then gives out a light white smoke in jets, and it is fit for use. When other asphalte is used, instead of the asphalte of Pyrimont, the quantity of bitumen to be added, will vary according to the particular nature of the asphalte, and the proper quantity will easily be found by trial, and when bitumen or mineral, or other pitch, than that from the neighbourhood of Pyrimont is used, the precise proportion will easily be determined by trial. In applying the said cement or composition to paving, I add to about every 200 pounds weight of the nearly fluid mastic cement, about half a bucket full of very small, clean, and hot gravel or sand; this is carefully stirred up with the mastic, and as soon as it is sufficiently fluid, that is as soon as the mastic begins to give out the light white smoke previously described, it is fit for use. It may then be run into moulds, and remain until cold, when it will form blocks or slabs, which may be laid upon any proper foundation, one consisting of concrete and mortar, is usually adopted. These blocks or slabs are cemented together, by pouring the fluid mastic cement either mixed as aforesaid, with fine gravel or sand or without fine gravel or sand, between the interstices of the blocks or slabs, sometimes a thin coating of mastic cement is spread over the foundation, and the blocks or slabs are imbedded therein, in such case the cement is also poured in between the interstices, as above described. If it be desired that the pavement should be ornamented so as to represent mosaic or other work, the process of forming the blocks or slabs is as follows:—

First, a large flat surface is formed, either of wood or plaster, upon which the required pattern is drawn: this surface, or a convenient portion thereof, is enclosed with iron bars of the intended thickness of the slab;

over this surface, a thin coat of transparent glutinous size, is spread; as the following work advances, pebbles of various colours, pieces of porcelain-ware, earthen-ware, glass, or other materials, of the required forms and colours, are deposited upon their allotted portions of the patterns, either to represent foliage or fret-work, or any other device; by means of the weak size, they are very lightly retained in their places, the mastic cement or composition heated as above, and either mixed with fine gravel or sand, as aforesaid, or unmixed, is poured into the space enclosed with iron bars as aforesaid. This mastic cement or composition, fills up the interstices between the pebbles, pieces of porcelain-ware, earthen-ware, glass, and other materials, and forms with them a hard slab—this is inverted, and slabs thus formed, are cemented together in the same manner as blocks or slabs are previously described to be cemented. In forming ways or paths I usually proceed thus. Upon a proper foundation, I place two flat iron bars parallel to each other at a convenient distance from each other, say, from three to four feet—these bars are of the thickness to which the the mastic cement or composition is intended to be spread, usually about half an inch thick; between these bars, the fluid mastic and fine gravel or sand, mixed as aforesaid, is poured and spread, and the surface made regular and uniform, by passing a thick piece of wood, with one straight edge, backwards and forwards upon the iron bars. Upon this surface, whilst still in a semi-fluid state, I usually sift fine hot gravel, which I beat into the mastic with wooden stampers. When the mastic is set, the operation is repeated until the surface required for the way or path is covered. As the operation proceeds, the surface of the cement already set, renders the use of the iron bars unnecessary.

I apply the said cement in road-making, either superficially in manner hereafter-mentioned, that is to say, upon the surface of a road formed of the usual materials, in the usual way, and the bottom whereof has undergone the usual preparations, I pour the said mastic cement or composition, either with or without fine gravel or sand, when the same is heated just so as to give out the light white smoke, as aforesaid, and the said mastic cement or composition, forms with such stones, a hard and compact surface; or I apply the said mastic cement under the hard materials, and in such case I spread a thin coating of the said cement, either mixed with or without fine gravel, or sand, between the substratum and the hard materials, for the purpose of preventing the hard materials being injured by the land-springs.

In applying the said cement or composition for the purpose of covering buildings, I usually cover the roof with canvas, similar to that used by the paper-hangers, stretched tolerably tightly, and upon this canvas I spread a layer of the said mastic cement, heated as last aforesaid, to about the thickness of four-tenths of an inch, and upon the surface of the said mastic, and when the same is in a semi-fluid state, I sift gravel previously heated in a caldron; and, as the mastic sets, I beat the said gravel into the said surface of the said mastic, with flat wooden stampers, about fifteen inches long and nine inches broad, until the gravel is incorporated into the substance of the said mastic.

The process of applying the said mastic to the lining of tanks, reservoirs, and various purposes to which cement, mastic, lead, zinc, or composition is employed, is very similar to that previously described. In such linings, no gravel or sand is used with the said mastic, but a coating thereof is applied whilst the mastic is of the heat hereinbefore-men-

tioned (that is to say), when it just begins to give out a white light smoke, previously described; for the bottom surface of tanks or reservoirs, a simple covering of the said mastic, applied in a manner aforesaid, is sufficient; for the sides of such tanks or reservoirs, the face of each brick, which is intended to be inwards, and exposed to the water, is first covered with a thin coat of the said mastic cement or composition; this is done by laying the bricks side by side, on a level of ground, as if they were to form a pavement, then the fluid mastic is thinly spread over their whole surface; as soon as it begins to set, which is in a few seconds, and before it becomes hard, the blade of a large knife is passed between the bricks, cutting the mastic through, at the same time the process leaves each brick with one face covered with the said mastic cement. This done, the walls or sides of the tanks or reservoirs, are built, and each brick is set in fluid mastic, instead of calcareous mortar or cement, and for greater security, a space of about half an inch is left between the inner and outer bricks, which form the side-walls of tanks or reservoirs: this space is filled up with the fluid mastic, as the brickwork advances; this is the process usually adopted. From the above descriptions of the application of the said mastic cement or composition, it may easily be applied to various other purposes, to which cement, mastic, lead, zinc, or composition, is employed. And whereas, I do not claim as the said invention, the mode of reducing the said asphalte to powder, or the separate use of the said asphalte, or bitumen, or mineral, or other pitch, as a mastic cement or composition; but I do claim, as the said invention, the combination, by means of heat, of asphalte, meaning thereby a natural compound, consisting principally of carbonate of lime and bitumen, with a small portion of aqueous and other matter, by whatever name or names such natural compound be called or known, and bitumen, or mineral, or other pitch, into a mastic cement or composition, applicable to paving and road-making, and various purposes to which cement, mastic, lead, zinc, or composition is employed. And such invention, being to the best of my knowledge and belief entirely new, and never before used within that part of Her said Majesty's United Kingdom of Great Britain and Ireland, called England, Her said dominion of Wales, or town of Berwick-upon-Tweed; I do hereby declare this to be my specification of the same, and that I do verily believe that this my said specification doth comply in all respects, fully, and without reserve or disguise, with the proviso in the said hereinbefore in part recited letters patent contained, wherefore I hereby claim to maintain exclusive right and privilege to the said invention.—In witness whereof, &c.—[*Enrolled May* 25, 1838.]

Rep. Pat. Inv.

The Asphalte Mastic is obtained from Pyrimont, near Seyssel, and brought down the Rhone, and is a compound of a carbonate of lime and mineral pitch. After being roasted on an iron plate it falls to powder, or may be readily pounded. By roasting it loses about one-fortieth of its weight. It is composed of nearly pure carbonate of lime, with about nine or ten per cent. of bitumen.

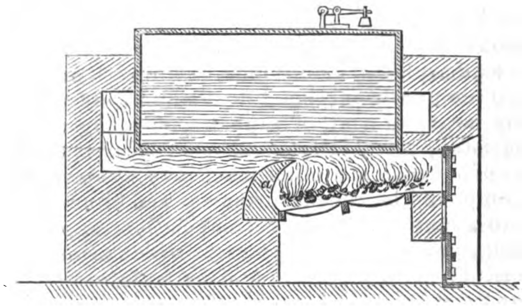
When in a state of powder it is mixed with about seven per cent. of a bitumen or mineral pitch, found near the same spot. This bitumen appears to give ductility to the mastic. The addition of only one per cent. of sulphur makes it exceedingly brittle. The powdered Asphalte is added to the bitumen when in a melting state; also a quantity of clean gravel, to give it a proper consistency for pouring it into moulds. When laid down for pavement, small stones are sifted on, and this sifting is not

observed to wear off. The mass is partially elastic, and Mr. Simms had seen a case in which a wall having fallen away, the Asphalte stretched, and did not crack. It may be considered as a species of mineral leather. The sun and rain do not appear to have any effect upon it; it answers exceedingly well for the floors of the abattoirs of the barracks, and keeps the vermin down; and is uninjured by the kicking of the horses feet. It may be laid down at from eightpence to ninepence per square foot.

Journ. Arts and Sci.

Specification of a Patent granted to John Hopkins, *of the county of Middlesex, surveyor, for his invention of improvement in furnaces for steam-engine boilers and other purposes.*—[Sealed 18th June, 1836.]

This invention consists merely of an improved fire bridge of a curved form, constructed in such a manner that the heat and the flames are arrested in their progress and thrown back from the end of the furnace, and in some measure caused to pass again over the surface of the burning fuel; by this means, the vapours arising from the combustion of that part of the fuel which is onlv partly ignited will be consumed.



The figure represents a longitudinal section taken through a furnace and steam-engine boiler, showing the position of the improved fire bridge, which is represented at *a*, and is constructed of fire brick; it will be seen that the fire bridge, instead of merely intercepting the flames, as in the ordinary construction, and causing the heat to rise upwards and act on the under surface of the boiler, by its bent form, causes the flames and heat to be driven back, and to act more effectually all along the under surface of the boiler.

The Patentee further states, that in marine and some other constructions of boilers, the fire bridge may be constructed of metal, and hollow, for the water of the boiler to pass into and become heated, instead of making it of fire brick.

It will be evident, from the foregoing description, that although the invention has been described as adapted to furnaces of steam-engine boilers only, yet it is equally applicable to the furnaces of other boilers in which bridges of the ordinary construction are used. In conclusion, the Patentee says, "Having now described the nature of my invention, and the manner of carrying the same into effect, I would have it understood that I claim, as my invention, the construction of the fire bridges of the furnaces of steam-engine and other boilers, as above described, either of fire brick, metal, or other suitable materials.—[*Inrolled December*, 1838.]

*An account of a recently invented Patent Spring, called "The Safety Spring," and applicable to Carriages and Carts of every description.** By the Rev. R. J. Barlow.

When springs were first brought into practice, they were imagined to be useful merely to give ease to the traveler, and a certain degree of security to fragile articles; reflecting persons, however, quickly discovered them to be a great means of saving the carriage and lessening the draught, which latter is clearly proved in the works of Drs. Helsham and Arnott. To save the road upon which we travel, has, since the formation of railways, become a consideration of the utmost importance, and so perfectly convinced are scientific men of the value of springs for that purpose, that the eminent engineer, Mr. Stephènson, does not permit a single wagon to be run upon the Manchester and other lines under his direction without springs, although the weight and expense thereby added to each wagon is very considerable.

Hence, it is evident, that besides the comfort and convenience of springs, their chief advantages consist in saving the horse or engine, the carriage itself, and the road upon which it travels; and consequently, the only argument against their being universally adopted by the Ordnance Department, and for farming carts, and common stage wagons, must arise from their being so expensive, so liable to break, and so ponderous when employed for heavy wagons, all which evils are in a great measure obviated by this invention, the peculiar properties of which may be thus briefly enumerated.

A greater degree of ease than those now in use;—almost perfect security against breaking, under any circumstances;—a saving of weight upon railways to the amount of three-fourths, upon the common roads to the extent of two-thirds;—much cheaper;—a direct up and down motion, which prevents the swinging and rolling of the carriage, and consequently secures it against being overturned under any extent of load;—simple, capable of being repaired by the most indifferent mechanic,—may, upon emergency, be increased in strength for bad roads and heavy luggage;—preserves the graceful appearance of the C spring so completely as to deceive the eye, and in all other cases is lighter and more elegant than those now in use.

That this spring is easier than those in general practice has been proved by comparing them with some of the best London manufacture for the space of a year, during which they were tried upon the worst description of roads: again upon the Whitby railway, where they have been in use for some months, they are found to have a much more pleasant motion than any hitherto employed. This is attributable solely to the spring being acted upon instantaneously, and completely without friction, which prevails to an enormous degree in the old springs, and renders them stiff or wooden to a great extent.

The superior security of this spring may be proved in this manner. The levers are constructed of two pieces of one-fourth inch plate iron, distant from each other, two or three inches, and connected by one or more small blocks of wood, or, as in the case of the C spring, by one solid piece, all firmly riveted together; by this means the iron receives the strain edgeways, and, like the blade of a saw, or knife, supported in such a position, it may, with little weight, be made equal to any load.

The spring itself never exceeds eight or ten inches in length, and con-

* Communicated to the Whitby Philosophical Society by the Rev. R. J. Barlow, the patentee, of Linden Grove, near Stokesby, Yorkshire, September, 1836.

sists of several steel plates of a lozenge shape, inserted in a kind of case called a stop (from its regulating the quantity of motion and stopping it at a certain given limit.) This stop, by its tongue running through the centre, divides the plates into upper and under series, and contains, at each end, a rack or rest for every plate, which being supported at the extremities, the whole spring is pressed in the centre directly like an elliptic spring, and since every plate is supposed to be capable of bending more than it is permitted, it is not possible that the spring can ever break, because it is checked before it reaches the breaking point. Let it not, however, be imagined, that being thus checked, the motion must be unpleasant, for if the spring be proportioned to the weight, it will never collapse but with such a shock as might endanger the carriage. It should also be mentioned, that whereas all springs are found to break, or set, and lose their shape and original position if too heavily laden, this safety spring will, on the contrary, always return to the same height, when the load is taken off, be it ever so great; for, as has been shewn, it is impossible to break the spring, and when it has gone home, the strain then becomes entirely upon the levers, which are made beyond any, even the utmost calculated weight or strain.

The difference of weight between these springs and the old ones, has been accurately determined at the Whitby Railway, and is as follows:—old springs for a 3 tons carriage, 372 lb.; new springs for a 3 tons carriage, 90 lb., being, as stated above, a saving of three-fourths in weight; but it is further to be remarked, that in the old springs, double the load requires double the weight of springs; whereas in this invention, the spring alone requires increase, directly as the weight, a few pounds additional to the levers being sufficient; thus, for instance, on the Whitby line, 3 tons take springs of 90 lb., but 156 lb., is sufficient for 6 tons, the levers being increased by only 6 lb.

The saving of expense is evident from the simple nature of the invention, because all the parts can, without loss of steel, or iron, be cut in the cold state by heavy machinery, after which little hand labour is necessary: again it is to be considered that there is never more than one-third of the material employed, and that one-half of that is iron instead of steel.

The direct up and down motion will thus appear. In all cases, such as public coaches, phaetons with perches, and gigs, where the springs can be conveniently placed so as to run, not across, but along, the axle, should the weight by a jerk be thrown to one side, the lever or levers on that side will work the springs, and those on the opposite side being freed from duty, will fall at the same time, by which means the carriage is compelled to descend at both sides alike, and therefore will move directly up and down only, so far as the springs are concerned; whereas with the present springs, when the weight is thrown to one side, the opposite side of the spring being relieved from pressure, kicks up, and tends much to make the carriage swing and overturn.

The facility of increasing the strength for bad roads or heavy luggage, will be understood by supposing the stop and the racks to be so arranged, as to be capable of receiving at the top and bottom one or more plates. This will materially increase the strength, and may be performed by an ordinary servant. In the levers no change is requisite, as they are always capable of working a spring of much greater power than would suit the carriage under ordinary circumstances.

Fig. 1.

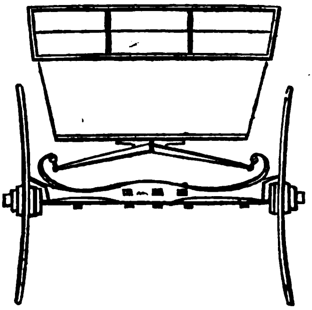


Fig. 1, exhibits the back of a phaeton hung so as to have the up and down motion, and avoid the side swing.

Fig. 2, represents the frame of a railway carriage, as seen with the patent springs and double guide plates of one-fourth inch plate iron, made, as shewn, of several pieces riveted together, or cut out of a single sheet. It is to be noticed, that the spring box plays within the guide plate, and thus the dirt and dust are kept from the oil, or the piece riveted on may be cut off, so as to allow the spring box to play outside, if preferred.

Fig. 2.

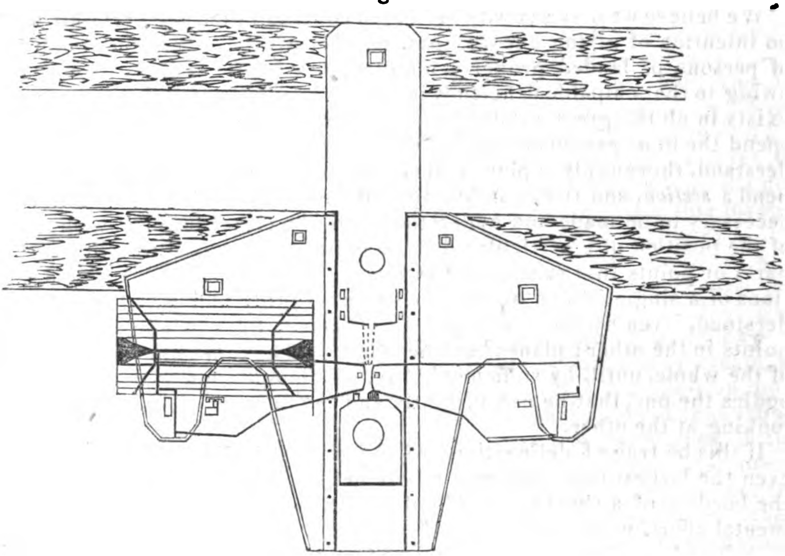


Fig. 3.

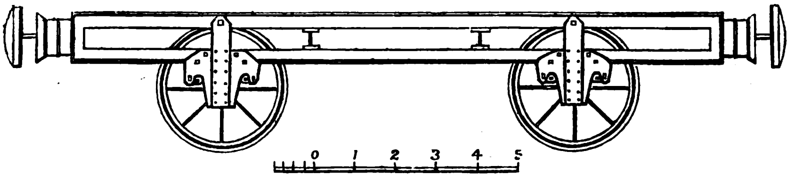


Fig. 3. exhibits, on a larger scale, the same kind of guide plate, which is expressed as if transparent, to render the inner works visible. Thus the shape of the spring box, the *position* of the syphon, the shape and action of the levers are apparent; and there is also displayed on one side a single spring of a 6 ton wagon inserted in its stop or case, the dark line being the tongue and rest.

In the plan above drawn, the carriages and wagons are hung lower than usual.

It may be necessary to add, that the small quantity of motion in the spring (not exceeding half an inch) is multiplied many times by the lever, before it is communicated to the carriage. **Ed. N. Philos. Journ.**

Progress of Civil Engineering.

Sectio-Planography.

We insert the following paper from the British Magazine of Popular Science, as well for the value of the mode of delineation it describes, as for the raciness of the style in which it is written. G.

We believe we may say without fear of contradiction, and certainly with no intention of giving offence, that, comparatively, a very small number of persons of landed property understand a *plan*. This is principally owing to that culpable deficiency in practical education, which at present exists in all the great establishments in which our more elevated ranks spend the most precious years of their lives. If but a small number understand, thoroughly, a plan, still smaller is the number who can comprehend a *section*, and that combination of both *plan and section*, which is necessary to be made and understood before a clear idea can be obtained of the position of a particular part or point, with regard to all the other parts or points that surround it in every direction. The plans and sections of a single edifice are not to be thoroughly and satisfactorily understood, even by the architect, at a glance; lines in one, shrink into points in the other; planes become lines; and he cannot prudently judge of the whole, until, by sufficient study, his imagination so distinctly embodies the one, that he can instantly and involuntarily combine it, when looking at the other.

If this be true of delineations of objects so limited in magnitude as even the largest mansions, and whose delineated areas rarely extend to the borders of a sheet of double-elephant, how far greater must be the mental effort, when designs run from sea to sea, over a country of varying altitude and depression, and whose delineations even when miles are compressed into inches, defy the continuous longitude of an "endless sheet." Persons who have never visited that Office of the House of Commons where the plans and sections of intended rail-roads are annually deposited, can have no idea of the scene. One would think that the whole country had been stripped of its epidermis, that it had been manufactured into striated paper, and deposited there.

When a *line* is to be examined in a committee of the House of Commons, it is soon found that it is not a mathematical one in any sense of the word. The *breadth* of the line, and its horizontal vagaries, generally require the broadest kind of paper, and sheet after sheet, or rather ream after ream, until the scale of length prescribed by the "Standing Order" is accomplished. The *depth* of the line, and its vertical undulations, are far more reasonable in their demand for breadth, yet they have the same insatiable appetite for length. When the plans and sections necessary for the inquiry intended first appear before a committee, they have no

very alarming appearance;—a portfolio, of no very gigantic dimensions considering the occasion, generally labelled "PLAN," in gold upon red, and a cylinder, perhaps a foot high, and of a diameter varying from two inches to eight, embodies the SECTION; but when under the process of examination, cross-examination, re-examination, and questions by committee, the engineer to the undertaking and his assistants, and the opposing engineers and their assistants, have turned over and turned back, unrolled and rolled, and unrolled again, portfolio and cylinder, with the most contrary intentions of comparing and combining, and proving and disproving, and have covered tables and floor with their convolutions, some little idea may be formed of the quantum of accurate informtion, which an impartial and constantly-attending member of a committee may obtain after fifty days' inquiry, particularly if he happen to be a "gentleman born."

But, as every country gentleman is not a member of a parliamentary committee, it may be hastily presumed that these perplexing mysteries can never annoy him. With the country, scored as it is with intended railways, no such gentleman can escape. This very portfolio and cylinder, or some few yards of each, is certain to roll into his hall, and be deposited on his library-table, either by friend or enemy, and he will find, sooner or later, that, though in undisputed succession of an ancestral estate, rich in preserves where poacher never entered, though a lover of that nature which has spread some of her loveliest scenes within his domain, and possessing health, and a keen relish for the field, this mysterious pair of unlike forms are the certain precursors of mighty evil. After a little time of execration on the COMPANY and their agents, he sits down with his attorney and surveyor. The three together can decide, within a mile, how near the railroad will approach that wood, or this lawn, and, perhaps, the amount of the lop-sided angle it will fill up of that sheet of water, which cost his grandfather thousands to create, in the geometrical style of gardening of his day. But the question, how the railroad is to maintain its level, and run down the side of that valley, and over that ridge, strikes out numerous inquiries, which end in the unrolling of the cylinder, and, in fact, nothing more; for after hours spent in attempts to combine the Section with the Plan; to connect the horizontal conditions of the one with the vertical conditions of the other, divorced as they are, the consultation generally ends, with, perhaps, a point or two accurately ascertained, but assuredly with a vexatious conviction, that some great mischief is about to be perpetrated, but in what way, or to what extent no clear notion has been obtained. What is the consequence? The landed proprietor either opposes the bill, shutting his ears against every proposition which might mitigate or remove the evil, and putting himself and the promoters to immense expense; or, as the final event is, nine times out of ten, the same, he saves great pain, cost, and vexation, by doggedly submitting to his executioners. His estate is then dismembered, and his enjoyments destroyed, in a legal manner, under the humane superintendence of the acting engineer of the company. In two or three years, if the calls are paid up, instead of the green, sheltered, turfed and meandering lanes, there will be the sterile, exposed, iron road, having the very picturesque qualification of "no curve of less radius than a mile." There, where the owner used to meet the lamb and its mother, and hear the tinkling bell of some fellow-wanderer he may be crushed by a locomotive; for though he hears its snorting a

mile off, he has but a second or two to climb the "cutting of one to one," to save his life. Game he may find at his poulterer's in Jermyn Street, but there is not a wing in his closest preserve.

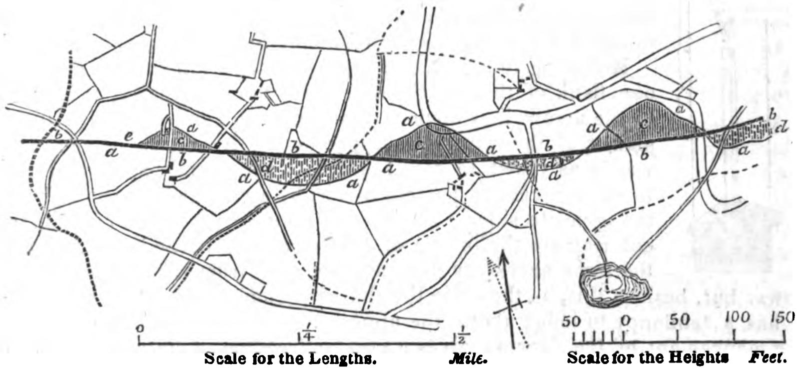
Mr. Macneill, by the invention we are about to notice, has made some small atonement for the terror he spread through the rural population a year or two ago, by his tables for facilitating "cuttings and embankments," and for the attacks his profession has hitherto covertly made upon the country and the dwellers therein, and against which there was little means of defence, for the extent of the evil threatened was always matter of doubt, and could be easily masked by bold assertion. A simple line running across a map, conveyed no notion of the gash that was to be so fearfully cut in that hill, nor of the dam that was to destroy the perspective of that valley, and choke the old acquaintance that once ran free and gurgling from one side of it to the other. It spoke not of viaducts from which passengers can now look into the chamber-windows of his mansion; and what was there in the solution of its continuity, those dots merely, by which tunnels could be predicted, in which nitrogen will never linger, and darkness be never dissipated? Yet, if this simple line be not early washed out from the map, by a process more expensive than a king's ransom, it may be legalized, may curse the ground on each side within a parliamentary boundary, driving out the astonished possessor, and teaching a fatal lesson of the consequence of "being troubled with a *line.*"

But the enemy cannot now make so secret an approach; he can no longer blind his victims by his worse than useless "Plan and Section." The prayer of Ajax is granted, to all who ask it, and would to all who don't, if those who make and unmake "Standing Orders" would do their duty.* Railroads must assuredly, in certain cases, be executed: but the mischief necessarily attendant and consequent upon these numerous, and often gigantic, projects, ought to be seen, and easily seen, by every eye, very long beforehand. Hitherto this has been impossible, principally from the difficulty of getting at a correct notion of where, in a vertical as well as in an horizontal direction, the railway was to go. The annexed specimen of a new mode of delineation, invented by Mr. Macneill, and designated Sectio-Planography, will show, at a glance, that this difficulty can be removed. Here, on the same surface, in close and natural combination, are,—the virgin surface of the earth previous to the visit of the fell engineer, and the plan-line and the section-line of the railway proposed,—the offspring of his unholy contact. Each may be contemplated by itself, or in combination with either or both of the others. Look at the natural surface-line, (*a a*,) and you can ascertain its correctness, &c.; for every point in it may be recognised by its juxta-position with the plan-line. Look at the plan-line, (*b b*); there may be seen, as usual, its direction, and its relation to lateral objects; but at every point in it you can estimate the facilities or the difficulties, by the coincidence with, or the departure above or below the surface-line, (*a a*). Now, suppose the paper were cut through along the latter line, (*a a*), and that, preserving the plan-line, (*b b*), in its present plan, the superior edges of the surface-line (*a a*), were elevated, and its inferior edges depressed, the whole section might be conceived to be turned upon the plan-line, (*b b*), as upon an axis, till it became vertical; it is now a section of the country, in its correct po-

* "Give me to see, and Ajax asks no more."—*Pope's Homer.*

sition as to the surface, and it gives a perfect representation of what must be done at all and every part of the line, to obtain the railroad at the given level. But the cutting of the paper is unnecessary. Raise the map with the section-plan so delineated from the table, and hang it on the wall. Now the section is vertical, and in its natural position, as before. Once familiarized with these experiments, neither is any longer necessary. A *coup-d' œil* of a sectio-plan laid down upon a map is no longer a limited and merely superficial view as in former years. It shows, previous to a great and important operation being performed, the wounds and the tumefactions which must be produced by the operator, however skilful, and if the party whose estate is to be operated upon is still "recusant," he can ascertain if it be worth while to cut his own throat, or that of the engineer, before the professional "cuttings" of the latter scare away the mountain-nymphs of his home.

Specimen of the Application of the Sectio-Planography, in the Delineation of a Survey for a Railroad.



Scale for the Lengths. *Mile.* Scale for the Heights *Feet.*

a Natural surface of the ground.
b The proposed Railroad.
c Its passage through elevated ground ; a case of "*Cutting*."
d Its passage across depressed ground ; a case of "*Embankment*."
e Its passage along level ground.

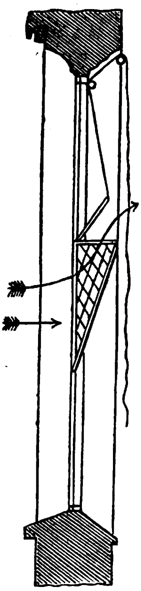
Mag. Popular Sci.

On the Ventilation of large Buildings by the Intervention of Openings in the Windows; by R. Mallet.

When in Liverpool, last September, at the meetings of the British Association, I went once to St. Jude's church. This edifice, which is in a sort of Gothic style, presents, when filled with people, a very imposing interior; partly from its magnitude intrinsically, but much more from this property not being, as it is so often, frittered away by innumerable divisions and subdivisions of parts, in the arrangement of ornaments on walls and ceilings. The ceilings are in this church particularly good, being simply divided across by the tie-beams (or representations of them) of the roof principals, which are moulded in a very bold style, and terminate at the walls in rich open Gothic brackets. The under line of these mouldings passes level and straight across, while the ceiling forms a large angle at the centre, probably

of about 160°; thus giving an aspect of great strength and solidity. But to the point. There are two rows of windows at either side, one over and one under the galleries; and each window has a considerable portion of the sash cut out, and inclined inwards, and so fixed; with glazed sides and an open top, furnished with a glazed lid to open and shut by a cord. Fig. 1, is a section of one of these, which represents them all, and is sufficiently plain without reference. The doors are judiciously contrived to prevent the currents of air which are often so distressing in churches; and hence ventilation may be considered as confined to these openings in the windows. Now, while the church is filling, and for, perhaps, the first half hour or so of service, nothing can be better than the ventilation: a delightful *aura* spreads through every part of the building, and feels fresh and breezy; but as the church heats this rapidly declines; and in about an hour, on putting my hand to one of the ventilators, where there had been a strong current in before, I could find none perceptible. This struck me as curious; and, on a little subsequent consideration, I believe I have seen the cause; and, as a great number of churches and other buildings are ventilated in this way, I have deemed it possibly worthy of notice in your Magazine.

Fig. 1.



Referring to Fig. 2, and supposing the wind to blow against one flank of the church, either direct or diagonally, as shown by the arrow, it is obvious that, pressing against the inclined planes of the ventilators, a portion of it will be driven upwards, as shown in Fig. 1, and into the church, and will tend to expel a certain portion of air, by a retrogade motion from the opposite side. The opposing forces that the air meets in entering are the inertia of the body of air in the building, and the force necessary to expel part of it from the leeward windows; but, besides this, as the air in the church becomes heated and ascends, it has a tendency to lodge above the upper row of windows, and, from the commencement of the process, gives a greater freedom of entrance to the fresh air below than above; but, as soon as the hot air above has increased

Fig. 2.

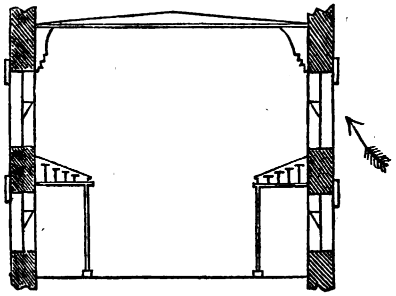
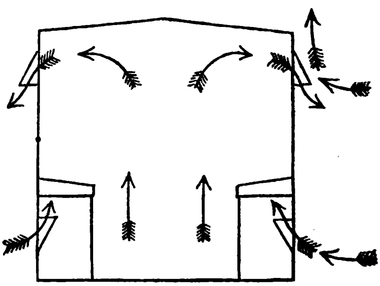


Fig. 3.



so as to have reached the level, or below the top, of the upper row of ventilators, the whole, or a part, of the current through them becomes stopped, depending on the temperature of the upper region; because this air to be displaced by fresh air, requires to be depressed into air colder, and hence denser, than itself, owing to the structure and position of the ventilators;

so that, in fact, at a certain period, dependent on the circumstances of external and internal cooling and heating agencies, the heated air becomes itself a valve to stop out the fresh air. Now the remedy for this is very plain, and consists merely in inverting one set or range of ventilators, as in Fig. 3, where I have represented a section of the church merely by lines. Here the upper ventilators are inverted; so that a lateral external current, instead of, as before, being urged by the inclined plane against the issuing hot air, is deflected upwards by it outside the building; while the slope of the ventilator gives at both sides free egress to the heated air, at the same time that the position of the lower ventilators is the best possible for freely admitting the external atmosphere. This is shown in the figure by the directions of the arrows, together with the ascending currents of heated air. The protection from rain is equally good in either case; and this latter modification would appear to afford a good and efficient system of church ventilation. Architec. Mag.

Death of Arthur Woolf.

The council of the Institution of Civil Engineering, have to regret the loss to the institution by death of its member, Arthur Woolf. This distinguished individual was born at Camborne, in Cornwall. He was a millwright, and in that capacity went to London, and was employed in Meux's brewery. In 1804, he took out a patent for his two-cylinder engine, working high-pressure steam in a small cylinder, and allowing it to expand in a large one. When he first commenced erecting engines in Cornwall, he induced the proprietors of the foundries to improve their machinery, that a better style of workmanship might be used in the manufacturing of steam-engines; and he introduced an improved Hornblower's double-beat valve. The work done at the Consolidated Mines, proves him to have been a person of great talents. In October, 1814, the average duty of the engines in Cornwall was 20½ millions—Woolf's engine at Wheal Abraham, however, performed 34 millions—and in December, 1815, 52 millions; and in May, 1816, 57 millions; while the average duty of all the engines reported in Cornwall was 23 millions. In 1820, Mr. Woolf erected engines at the Consolidated Mines having cylinders of 90 inches in diameter, and a stroke of 10 feet—the most powerful that had ever been constructed. In December, 1827, a trial took place with one of Woolf's 90-inch engines, and it performed a duty of 63½ millions—the average duty of 47 engines reported in this year was 32 millions. For some years before his death he received a pension of 100*l.* a year from the proprietors of the Consolidated Mines. His name is associated with the improvement in the drainage of the Cornish mines; and whatever share posterity may assign to his individual genius in these improvements, his name is recorded in the page of history among those who have dedicated their talents and the opportunities of a long life to the advancement of practical science. Jour. Arts & Sci.

Plymouth Breakwater.

The violent gales of the 24th and 25th of Feb. last, produced their effects on the Breakwater at Plymouth, and owing to its greater exposure, they were mostly confined to the western area. So great was the force

of the sea, that 8,000 tons of stone from the outer fore shore, or foundation of the structure, were fairly lifted by it, and thrown from the outside over this wall of masonry into the sound. It is a curious fact, that the mass of these stones were principally lifted from opposite the circular end on which the lighthouse is to stand, and deposited in an E.N.E. direction from whence they came, thus showing the direction in which the action of the sea was strongest. The upper part of the Breakwater also suffered severely, many large granite blocks, weighing from three to nine tons, of which it is formed, (being firmly cemented and dove-tailed into each other,) having been displaced and washed over into the sound. This is supposed to have arisen from the compactness of the work not allowing the free escape of the water in the body of the structure when acted on by the great pressure of the external waves. Upwards of 250 tons of this work have been displaced, and carried over to the north side of the Breakwater. The tide on this occasion rose 5 feet 6 inches higher than usual, and within 6 inches of the great tide of 1824, when a breach was made by the sea in the main body of the work. Nautical Mag.

Mechanics' Register.

New Cordage.

The brothers Landauer, of Stuttgard, have obtained a patent for a new species of cordage; the threads of which are not twisted one over the other, but united in a parallel direction. A cord, 1¾ inch in circumference, sustained a weight of 1300lbs. without breaking; and when at last an additional weight caused it to break, the fracture resembled a cut with scissors, which proves that each thread was of equal strength. A cord of 504 threads, 3$\frac{3}{16}$ inches in circumference, 111 feet long, woven in this manner, only weighed 19lbs.; whilst an ordinary cord of the same circumference and length, and as many threads, weighed 51½lbs. Mech. Mag.

Mr. Crosse's Experiments.

The *Morning Post* publishes a letter which Mr. Clark has received from Mr. Crosse, relative to the result of the interesting experiments which the latter gentleman has undertaken for the development of insect life in solutions of silica (flint) by the long continued application of voltaic electricity. Mr. Crosse, in his letter, says, "I send you by my friend, Mr. ——, a small bottle of spirits of wine, containing about thirty insects, produced in silicate of potash, under the long-continued action of voltaic electricity. I am quite as much surprised and quite as much in the dark about this affair as I was at first. I have had lately several new families of them, and have them at this present time growing on a piece of iron-wire plunged into silicate of potash, and a quarter of an inch under the surface of the fluid, at the positive pole of a battery consisting of twenty pairs of small zinc and copper cylinders. I likewise have them forming on the surface of constantly-electrified sulphate of

copper, at the edge of the fluid, and strangely mixed up with crystals of sulphate of copper. In fact, I have them in all stages, from their earliest formation to full perfection, and crawling about pretty nimbly. Most of these formations took place in the dark. The access of light is very prejudicial to them, as far as I have observed. I have hundreds of vessels of the same water as that used in the solution in the same room, and in other rooms, with not the slightest appearance of a similar insect, or the germ of one. In one of these experiments the vessel was covered with paper, and yet the insects were formed as before. Of course I have no merit to claim in the affair; it was pure accident, and the looking for artificial minerals brought them to my notice." Mr. Crosse states that he is preparing an apparatus to repeat the experiments in a more unexceptionable manner, and until then does not wish to enter into detail on the subject.

Mining Jour.

New Invented Steam Engine.

At the British Alkali Works, Stoke Prior, near Bromsgrove, a steam engine has been invented by a labouring mechanic, and is daily in full operation, which will certainly supersede every other now in use, and that, too, in a very short period of time; as the simplicity of its construction, the smallness of its size, and the almost nothingness of its cost, will necessarily bring it speedily into notice among all persons whose business may require the aid of so useful an auxiliary. Its size is not more than twice that of a man's hat, and the expense of a five-horse power will not exceed in cost half a score pounds. Its form is cylindrical, being about eighteen inches in diameter, and twenty-two deep. The steam is admitted through a hole in a hollow circular belt (attached to a wall), upon which it revolves, and works it by a diagonal action, against an upright piston, being forced out by pressure of a diagonal plate, which divides the interior into two portions. The rotary action is beautifully managed by means of a perfectly spherical steam-tight joint, at the end of a fixed inclined arm, towards which joint the upper and lower surfaces of the interior part of the cylinder are made to slope, after the form of an hour-glass. Upon these the diagonal plate performs its revolutions, such movement being permitted through an opening (from the circumference to the centre), equal in width to the thickness of the before-mentioned upright piston, up and down the sides of which it continually works. To the centre of the bottom of the cylinder is fixed a shaft, having attached to it a wheel which communicates the motion that may be required; and this is all the machinery of which it consists!! When, therefore, we consider the saving of weight of metal, size, and expense, which will necessarily be gained by its adoption, and look at the incalculable advantages which such desiderata afford to steam navigation, our scientific friends will not consider us too bold in asserting that this invention will speedily revolutionize the whole system in this department of mechanics. Patents have been procured from every European government, and from the American; and no secret is made at the Works in showing it to the public, either in action or in separate pieces, and in a model which is kept for the purpose.

Ibid.

The Stafford Safety Coach.

This invention was described some time back. Since that time a coach built on the principle of the patentee, has been running to Nottingham, and has perfectly answered the object of the builders. The great desideratum is the safety of the coach from being overturned, however great the inequality of the surface of the road may be, or in the event of the wheels on one side being lifted from the road upon the pathway, or upon any heap of gravel or rubbish on the road-side, by the horses becoming unmanageable, or by any other occurrence that may propel the carriage out of the ordinary run of the road. The body of the coach being suspended upon springs placed nearly at the top of the coach, and supported upon strong pieces of timber, forming almost an angle, which are at the lower extremities inserted in the axletrees of the front and hind wheels, is kept under all circumstances in a perpendicular position, and the centre of gravity is thrown considerably lower than in coaches built upon the old and common plan. Increased speed may be used without danger by this invention. The carriage is also much lighter; it is calculated that one-horse power is saved in the draught, and the wear and tear is also less. This coach may be used on roads of all constructions, and will not be liable to the danger which arises from coaches traveling upon roads high in the middle or low on the sides, or rounded in the old-fashioned mode of road-making. Most roads are now completely flat, which secures safety to vehicles built on the old plan, but it greatly increases the county rates, by causing the necessity of employing additional labour to scrape off the mud and water which gather on them, but which if they were constructed on a curve, would be unnecessary. The safety coach proceeded yesterday with a heavy load of passengers from Brickfriars to Hayes. In going down Notting-hill it was driven with great velocity, perhaps at the rate of sixteen miles an hour; nevertheless there was no rocking nor jolting. The body preserved its equilibrium in the roughest parts of the road, and fully answered the purposes for which the patent has been granted. Farmers' Mag.

Thrashing Machine.

A thrashing machine manufactured by Mr. L. Beare, of Meeth, near Hatherleigh, has been lately put to work on a farm in the parish of Landkey, near Barnstaple, when an acre of barley was taken in, and thrashed in eighteen minutes, yielding forty bushels of grain. Many respectable farmers were present, and expressed themselves highly pleased and satisfied with the performance of this surprising machine, as the barley was perfectly fit for seed or malting, every grain being free from damage. Ibid.

Relative height of the Caspian and the Black Sea.

The trigonometrical survey of the country situated between these seas, undertaken by order of the present Emperor of Russia, have now been completed. Several interesting results derived from this survey, has been communicated in a letter lately addressed by the celebrated astronomer Struve, of the University of Dorpat, to M. Von Humboldt. Among other disputed points which the engineers engaged on this work have established, is the relative height of the Caspian and the Black sea. They have ascertained that the Caspian lies 101 Russian feet (twenty-four French feet) below the level of the Black Sea. A full report is shortly to be published in the *Bulletin Scientifique* of the St. Petersburgh Academy. Min. Review.

Concentric Galvanic Piles.

M. Jules Guyot has just announced the construction of galvanic piles of a peculiar form, which he calls concentric piles. In these piles one pole is at the centre, and the other at the circumference. New properties and remarkable analogies are said to result from this combination, as we find at the surface of spherical piles made to revolve, all the influences of gravity and terrestrial magnetism at the surface of our globe. A pile four inches in diameter, composed of concentric cylinders two inches high and six in number, being charged with pure water, gives strong shocks even after the lapse of twenty-four hours. Mining Jour.

Voyages of Discovery.

These expeditions are not now confined to England, France, or Russia, but private merchants have entered upon them. The house of Grenut, & Co., of Geneva, who carry on a large trade in the whale fishery in the North and South Seas, are fitting out one of their largest whalers for a voyage round the world, without any limitation of time, for the purpose of prosecuting zoological and botanical discoveries. They have made an offer to an eminent naturalist at Geneva, to convey him, without charge, to all places of interest, upon condition of his placing in the museum of that city the collection which he may form. The expense of the voyage is to be defrayed from the private purse of the Baron de Grenut, and his public spirit is much applauded.—*Italian Paper.*

Ibid.

Sugar from the Pumpkin.

A complete revolution is expected to take place in the manufacture of native sugar—a revolution which will probably compel the beet-root growers to "hide their diminished heads." In other words, the pumpkin is about to enter the field as a rival of the beet-root, and to force the Chamber of Deputies to revise its late enactment on the sugar question. We hear that an industrious speculator is on the point of establishing a manufactory for extracting sugar from this overgrown and hitherto despised production of the vegetable world, the first experiments on which, it is added, have been crowned with complete success.—*French Paper.*

Ibid.

Iron Steamers.

The iron steam vessel, *Voador*, has, we understand, arrived at Pernambuco, after a passage of actual steaming of only four and a half days from Maranham. Sailing vessels are generally, we believe, twenty or thirty days making this passage, and a fast-sailing vessel arrived at Pernambuco two days before the *Voador*, that had been thirty-five days on the voyage from Maranham. This proves the great advantage to be derived from the introduction of steam vessels on a coast where the current and wind prevail so as to prevent sailing vessels accomplishing their passage in a reasonable time, and must shortly lead to the adoption of steam vessels both on the east and west coast of South America.—*Gore's Liver. Adv.*

Ibid.

AGENCY FOR PATENTS.

The Editor has again opened his office in Washington for the transaction of all business relative to Domestic and Foreign Patents. See advertisement on the cover.

There are no Occultations of Stars to the sixth magnitude visible in Philadelphia, in the month of February, 1839.

S. C. WALKER.

Meteorological Observations for August, 1838.

Moon.	Days	Therm. Sun rise.	Therm. 2 P.M.	Barometer. Sun rise.	Barometer. 2 P.M.	Wind. Direction.	Wind. Force.	Water fallen in rain.	State of the weather, and Remarks.
				Inch's	Inch's			Inches.	
	1	74	87	29.80	29.80	W.S.W.	Calm.		Clear—flying clouds.
	2	67	84	90	30.00	N.N.E.	Brisk.		Lightly cloudy—clear.
	3	64	84	30.00	00	W.N.W.	do.		Clear—flying clouds.
	4	64	87	10	10	W.	Calm.		Clear—flying clouds.
☉	5	69	85	00	29.93	W.	do.		Lightly cloudy—do. do.
	6	74	94	29.70	75	N.	do.	.45	Clear—showers.
	7	74	91	80	80	W.N.W.	Brisk.		Lightly cloudy—do. do.
	8	71	87	30. 00	30.00	E.N.E.	do.		Lightly cloudy—cloudy.
	9	77	82	00	29.94	S.SW.	Ca'm.		Cloudy—flying clouds.
	10	73	85	29.90	90	N.W.	Brisk.		Cloudy—do.
	11	73	70	90	77	S.W.	Calm.		Lightly cloudy—cloudy.
☽	12	72	85	74	74	N.W.	Brisk.	.75	Clear—fly. cl'ds.—rain in night.
	13	67	84	90	94	N.W.	Calm.		Clear—do.
	14	64	76	30.04	30.05	E.	Brisk.		Cloudy—cloudy.
	15	59	79	10	07	S.W.	Calm.		Clear—cloudy.
	16	68	82	29.90	29.90	S.	do.	.13	Cloudy—cloudy—rain in night.
	17	70	79	60	70	N.W.	Moderate.		Clear—flying clouds.
	18	65	70	80	73	W.	Calm.		Clear—clear.
⊗	19	62	79	95	30.03	W.N.W.	do.		Clear—do.
	20	65	82	30.10	13	E.	do.		Clear—do.
	21	65	84	13	10	S.W.	do.		Cloudy—do.
	22	71	90	10	04	W.SW.	do.		Clear—do.
	23	73	86	.05	07	S.W.	do.		Cloudy—clear.
	24	69	89	.02	29.91	S.W.	do.		Clear—do.
	25	72	89	29 85	80	W.S W.	do.		Cloudy—clear.
	26	72	77	70	72	N.N.W.	do.		Clear—flying clouds.
	27	54	69	81	87	N.N E.	do.		Lightly cloudy—do. do.
☾	28	70	83	64	66	N.	do.		Cloudy—flying clouds.
	29	61	80	92	30.00	N.N.E.	Moderate.		Clear—do.
	30	68	84	30.00	29.90	N.N.E.	Calm.		Cloudy—clear.
	31	60	82	00	90	W.S.W.	do.		Clear—do.
	Mean	64 42	82.74	29.92	29.91			1.33	

	Thermometer.	Barometer.
Maximum height during the month.	94. on 6th.	30.13 on 20th and 21st.
Minimum " " "	54 27th.	29.60 17th.
Mean	73.58	29.91

INDEX.

AMERICAN PATENTS, LIST OF, WITH EDITOR'S REMARKS, &c.